The Engineer

OCTOBER 30, 1953 28, ESSEX ST., STRAND, LONDON, W.C.2. TWO SHILLINGS

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RAPIER

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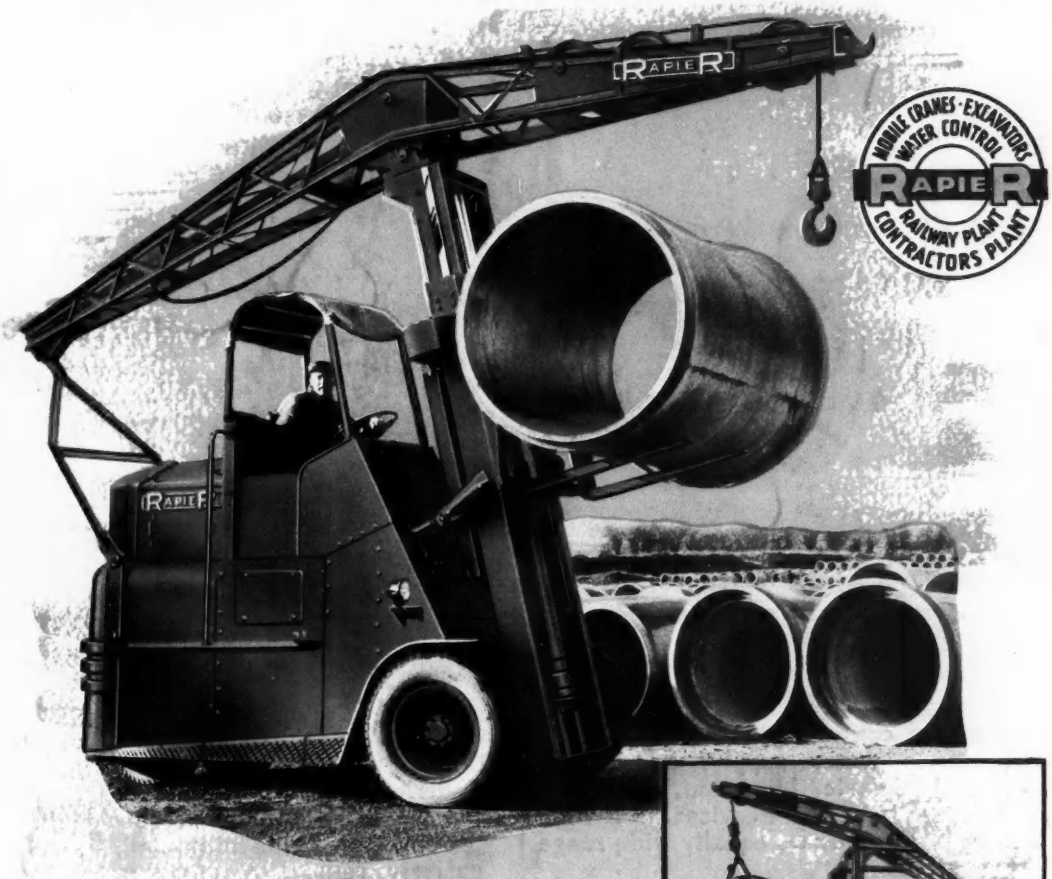

The RapieR Fork Truck Crane offers the best of two worlds in that it is a Heavy Duty Fork Truck to which is attached a patented Cantilever Jib giving first-class Mobile Crane service for handling those loads which are out of reach of the forks.

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Constructed of Meehanite cast iron, with faces of gun-metal or stainless steel and with spindles, either internal or external, of solid forged bronze, mild steel or stainless steel.

The electric motors are of the high torque induction type and transmit their power to the spindles through machine cut gearing in totally enclosed oil baths. Motors of 3 h.p. and over are fitted with the "Glenfield" torque limiting arrangement, controlled by electrical means, to restrict applied torque to predetermined values.

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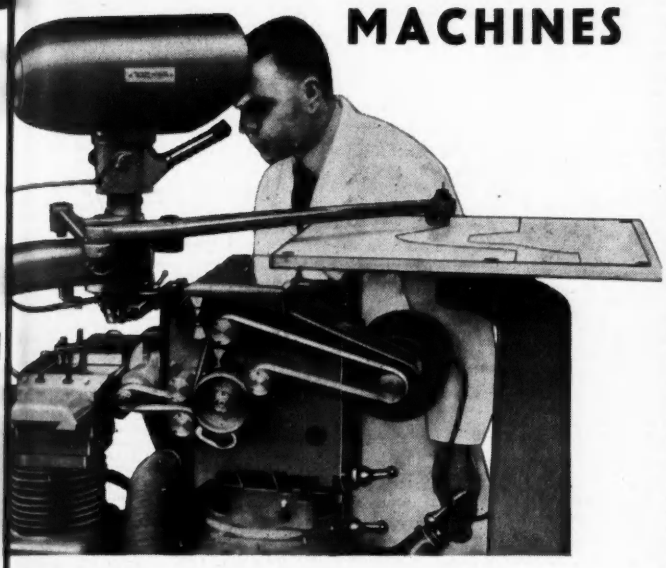

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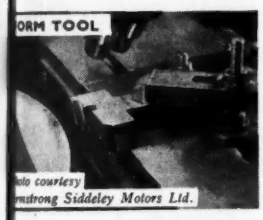
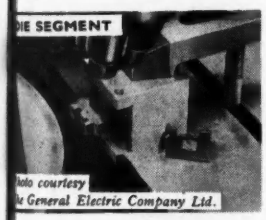
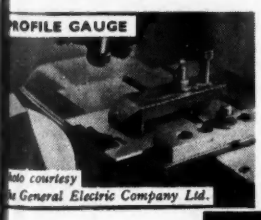
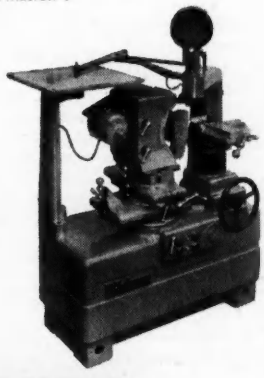






These machines are currently used in the toolrooms of a host of important aircraft, automobile, watchmaking and general engineering organisations for the production of profile gauges, form tools, press tools and many other highly precise aids to production. We would like you to meet some of the users —"The most helpful piece of equipment we've got," says one: and another, "We could not produce our type of work without it." Why not let us take you round, or send you fuller information ?



Wickman

WICKMAN of COVENTRY

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THE ENGINEER

ESTABLISHED 1856

Vol. 196 No. 5101

OCTOBER 30, 1953

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NOTICE TO READERS

All letters intended for insertion in 'The Engineer' or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications. No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.

SUBSCRIPTIONS

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WORDING OF ADVERTISEMENTS: Approximately the first 25 letters of each advertisement are set in heavy type. Advertisers are therefore advised to begin their advertisements with the words they want emphasized.

Advertisements received by Mid-day Tuesday will appear in the issue of Friday the same week. Orders must be accompanied by a remittance.

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PUBLIC APPOINTMENTS

THE UNIVERSITY COLLEGE OF KHARTOUM, SUDAN

LECTURESHIP OR ASSISTANT LECTURESHIP IN CIVIL ENGINEERING OR SURVEYING

Applications are invited for appointment to a LECTURESHIP or ASSISTANT LECTURESHIP in CIVIL ENGINEERING or SURVEYING.

Salary on scale : Lecturer, £E.1150 by £E.75 to £E.1525 p.a. ; Assistant Lecturer, £E.950–£E.1000–£E.1075 p.a. Status and point of entry in scale according to qualifications and experience. Cost-of-living allowance at present £E.144 p.a. Outfit allowance £50 on first appointment. Paid passages for member of staff and assisted passages for family on appointment, termination and leave (each long vacation after the first). No income tax payable at present in the Sudan. £E.=£1 6d.

Applications (six copies), giving full details of qualifications and experience and the names of three referees, should be sent to the Secretary, Inter-University Council for Higher Education in the Colonies, 1, Gordon Square, London, W.C.1, from whom further information may be obtained. Closing date, 30th November, 1953. E5872

ROYAL TECHNICAL COLLEGE SALFORD

Principal : P. F. R. VENABLES, Ph.D., B.Sc., F.R.I.C.

MECHANICAL ENGINEERING DEPARTMENT

ASSISTANT, GRADE B

Applications are invited for the post of ASSISTANT, Grade B, in the Mechanical Engineering Department. Applicants should hold graduate and/or professional qualifications and have had good industrial experience.

The successful candidate will be required to teach general mechanical engineering subjects to Ordinary National Certificate standard and to offer specialised subjects to Higher National Certificate standard.

Further particulars and forms of application may be obtained from the Principal, Royal Technical College, Salford, 5, to whom they should be returned within a fortnight of the appearance of this advertisement.

H. H. TOMSON,
E5844 Clerk to the Governors.

ADMIRALTY

ROYAL NAVAL SCIENTIFIC SERVICE

ENGINEERS AND PHYSICISTS

ENGINEERS and PHYSICISTS (particularly with electronics) required for appointments in Experimental Officer and Assistant Experimental Officer grades in Experimental Establishments in London, Portsmouth, Weymouth and Gloucestershire areas and Scotland. Candidates, British subjects, must possess one of the following qualifications :—University Degree in Science, Engineering or Maths. ; Graduate Membership of appropriate professional Institute ; Higher National Certificate, Final Certificate of five-year grouped course in relevant subjects at City and Guilds of London Institute or comparable institution ; Higher School Certificate, General Certificate of Education, Scottish Leaving Certificate, Scottish Universities Preliminary Examination, Northern Ireland Senior Certificate (all in appropriate subjects and at appropriate levels). London salary inclusive of pay addition (men), E.O.s, £681–£838, A.E.O.s (according to age), £274–£607. All appointments unestablished, but with some opportunities to compete for established posts.—Application forms from M.L.N.S., Technical and Scientific Register (K), 26, King Street, London, S.W.1, quoting A 247/52/A. E5863

MINISTRY OF LABOUR AND NATIONAL SERVICE

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

SCIENTIFIC OFFICERS

Department of Scientific and Industrial Research require two SCIENTIFIC OFFICERS (unestablished) at their Road Research Laboratory, Harmondsworth, West Drayton, Middlesex, one for research on bituminous road materials and associated machinery, and one for soil mechanics and earthmoving machinery. First or Second-Class Honours Degree in Civil Engineering required. Experience in applied research, highway engineering or contracting desirable. Inclusive annual remuneration for a 45½-hour week £441–£820 (men), women somewhat less. Prospect of permanent pensionable posts for candidates under 28. Reference E 398/53.—Application forms from M.L.N.S., Technical and Scientific Register (K), 26, King Street, S.W.1. E5862

BRITISH RAILWAYS

SCOTTISH REGION

CIVIL ENGINEERING ASSISTANTS

Applications are invited for TEMPORARY ASSISTANTS for Railway Civil Engineering Office in Glasgow. Men with experience as draughtsmen on civil engineering work would be considered. Work covers preparation of plans and estimates, including office and field work, also working drawings. Salary according to age and qualifications—Apply to Civil Engineer, St. Enoch Station, Glasgow. E5833

PUBLIC APPOINTMENTS

CITY AND COUNTY OF KINGSTON UPON HULL

CITY ENGINEER'S DEPARTMENT

APPOINTMENT OF MECHANICAL AND/OR ELECTRICAL ASSISTANT

Applications are invited for a post of MECHANICAL and/or ELECTRICAL ASSISTANT.

Salary A.P.T. Grade VIII, commencing at £760, rising by annual increments of £25 to £835 per annum.

Applicants must be chartered civil, mechanical or electrical engineers with comprehensive experience in the design of the general mechanical and electrical equipment of public buildings and public utility works. Preference will be given to candidates having specialised experience in the design of steam generating plant and installations, or in the design and operation of heavy stationary diesel and diesel electrical installations, or in the design of heavy-duty pumping plant or in the design of high-tension electrical substation and industrial control installations. Industrial experience is desirable and previous local government service not essential.

Housing accommodation will be provided for a successful married candidate if required.

Application forms may be obtained from the City Engineer, Guildhall, Kingston upon Hull, to be returned fourteen days after the publication of this advertisement.

Any applicant canvassing a member of the Council or chief official will be disqualified.

WM. MORRIS,
O.B.E., M.I.C.E., F.R.I.C.S.,
E5858 City Engineer.

HER MAJESTY'S COLONIAL SERVICE

PUBLIC WORKS DEPARTMENT, NIGERIA

ENGINEERS, WATER SUPPLIES

Applications are invited for the following posts :—ENGINEERS, WATER SUPPLIES, Public Works Department, Nigeria.

Several vacancies exist for civil engineers with experience in rural and urban water supply. Their duties will involve the survey, design and construction of earth or concrete dams, purification and pumping plants and distribution mains of all kinds.

Appointment may be either on probation for pensionable employment with gross emoluments in the range £830–£1560 p.a., or, if on contract terms, in the range £895–£2000 p.a. Officers appointed on the latter terms will receive, on satisfactory completion of contract, a gratuity of £25 for each three months' period of service or at the rate of £37 10s. where gross salary is £1000 p.a. or more.

Candidates should hold either a recognised University Degree or Diploma in Civil Engineering carrying exemption from Sections I and II of the Institution of Civil Engineers' Examinations, and have had not less than two years' practical experience in water supply, or be Corporate Members.

Further details on application.

Apply in writing to the Director of Recruitment, Colonial Office, Great Smith Street, London, S.W.1, giving briefly age, qualifications and experience. Mention the reference number CDE 112/14/06–07–08. E5856

LONDON ELECTRICITY BOARD

CHIEF ENGINEER'S DEPARTMENT

Applications are invited for the following positions in Central London.

STRUCTURAL ASSISTANTS and STRUCTURAL DRAUGHTSMEN (Construction Branch).

Applicants for positions of Structural Assistants should have experience in the design and detailing of reinforced concrete heavy foundations, framed superstructures, and other structural works. Applicants for Structural Draughtsmen should have experience in detailing reinforced concrete structures.

The posts are graded under Schedule "D," National Joint Board agreement as Grade 5—£595 7s. to £704 11s. and Grade 6—£458 to £595 7s. per annum, respectively, inclusive of London Allowance. Commencing salaries will be dependent upon qualifications and experience.

ARCHITECTURAL DRAUGHTSMAN

Applicants should be neat draughtsmen and preferably have had several years' experience in an architect's office.

The post is graded under Schedule "D" of the National Joint Board agreement as Grade 6—£458 to £595 7s. per annum, inclusive of London Allowance.

Application forms obtainable from Establishments Officer, 46, New Broad Street, E.C.2, to be returned completed by 21st November, 1953. Please enclose addressed foolscap envelope.and quote Ref. V/1683/EE on all correspondence. E5873

THE BRITISH IRON & STEEL RESEARCH ASSOCIATION

FUEL TECHNOLOGY SECTION OF THE PHYSICS DEPARTMENT

GRADUATE

GRADUATE required by the Fuel Technology Section of the Physics Department to investigate problems associated with the heating of steel in industrial furnaces. Applicants should be Graduates in Science, Technology or Engineering, with preferably strong Mathematical background to use statistical methods and undertake problems of unsteady heat flow.

Starting salary up to £650 p.a., according to age, qualifications and experience ; age 23–26. Post is superannuated under the F.S.S.U. Location of work London.—Written applications only, quoting "Fuel," to Personnel Officer, B.I.S.R.A., 11, Park Lane, London, W.1. E5859

PUBLIC APPOINTMENTS

HER MAJESTY'S COLONIAL SERVICE

PUBLIC WORKS DEPARTMENT

ASSISTANT ENGINEERS

Applications are invited for the following posts :—ASSISTANT ENGINEERS, Public Works Department, Tanganyika.

Appointment is on probation for permanent and pensionable establishment. Salary in incremental scale £655–£1320 p.a., plus a temporary variable non-pensionable allowance, up to a maximum of £350 p.a.

Candidates must hold a recognised University Degree or Diploma in Civil Engineering carrying exemption from Sections I and II of the A.M.I.C.E. examinations, and have had at least two years' approved practical experience, or be A.M.I.C.E. Duties will include surveys, reports, designs, specifications for civil engineering works, and administration, organisation and supervision of the construction and maintenance of such works.

Full details on application.

Apply in writing to the Director of Recruitment, Colonial Office, Great Smith Street, London, S.W.1, giving briefly age, qualifications and experience. Mention the reference number CDE112/8/03. E5876

STAFFORDSHIRE POTTERIES WATER BOARD

RESIDENT ENGINEER

The Board invite applications for the post of RESIDENT ENGINEER on works of water supply, comprising a 1 million gallon reinforced concrete service reservoir and 9in., 12in. and 18in. spun iron water mains, at a salary of £15 per week. It is estimated that the time required for the completion of these contracts will be approximately 18 months, and at the end of this time it is anticipated that further service reservoirs will be under construction.

Applications, stating age and giving full details of experience, accompanied by copies of two recent testimonials and endorsed "Resident Engineer," must reach the undersigned not later than Saturday, the 14th of November, 1953.

Canvassing in any form will be deemed a disqualification.

C. V. BROWN, M.I.C.E., M.I.Mech.E., M.I.W.E.,
Engineer and Manager.
Engineer's Office,
Albion Street,
Hanley,
Stoke-on-Trent. E5880

BRITISH ELECTRICITY AUTHORITY

(MIDLANDS DIVISION)

GENERATION ENGINEER (OPERATION)

British Electricity Authority (Midlands Division) require a GENERATION ENGINEER (Operation).

Candidates should preferably be Corporate Members of one or more of the recognised Engineering Institutions and be familiar with the operation of modern H.P. plant. The salary will be within the provisional salary range, £1325–£1800 p.a.

Applications, stating age, present position and salary, and giving full details of qualifications and experience, to D. Moffat, Director of Establishments, British Electricity Authority, Winsley Street, London, W.1, by 14th November, 1953. Quote reference AE/426. E5828

CITY OF BIRMINGHAM

PUBLIC HEALTH DEPARTMENT

SMOKE AND FACTORIES INSPECTORS

Applications are invited for the above posts from candidates possessing the Board of Trade (Steam) Engineering Certificate or its equivalent. Applications from qualified Sanitary Inspectors holding the Royal Sanitary Institute Smoke Inspectors' Certificate will also be considered.

The duties include the abatement of atmospheric pollution and noise, inspection of factories and workplaces and the duties as an authorised officer under the Heating Appliances (Fire Guards) Act, 1952.

Salary within A.P.T. Grades I to V (£465–£645 per annum), according to qualifications and experience ; pension scheme, including widows and orphans ; medical examination.

Applications, stating age, qualifications, present salary, length of service and experience, together with the names of two referees, should be sent to the Medical Officer of Health, Public Health Department, Congreve Street, Birmingham, 3, not later than 21st November, 1953. E5879

SENIOR DRAUGHTSMAN

NIGERIAN GOVERNMENT RAILWAY

SENIOR DRAUGHTSMAN (Engineering) required by the Nigerian Government Railway for one tour of 18 to 24 months in first instance. Salary, &c., in scale £1170, rising to £1453 a year. Gratuity at the rate of £150 a year. Outfit allowance £60. Free passages for officer and wife and assistance towards cost of children's passages or their maintenance in this country. Liberal leave on full salary. Candidates must have extensive experience in preparation of design and working drawings for railway track layouts.—Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M2B/29981/EH. E5875

PUBLIC APPOINTMENTS

BRITISH ELECTRICITY AUTHORI

SOUTH-EAST SCOTLAND DIVISION

SECOND ASSISTANT ENGINEER (MECHANICAL)

Applications are invited for the position SECOND ASSISTANT ENGINEER (Mechani Generation Construction Department, Divisi Headquarters.

Applicants should be experienced in the de and construction of turbo-generators, boilers, and ash handling plant, high-pressure steam and piping and other ancillary work.

Experience in the preparation of specificati estimates, analysis of tenders, and a knowledg thermo-dynamics and hydraulics will be a rec mendation.

Preference will be given to applicants who ho Degree in Mechanical Engineering, are Corpo Members of the Institution of Mechanical Engi or possess equivalent qualifications.

The salary will be within Schedule C, Class AX Grade 2 (£834–£997 per annum) of the Nati Joint Board Agreement.

Applications, stating age and experience, Monday, 9th November, 1953, to the Divisi Controller, British Electricity Authority, South-E Scotland Division, British Electricity House, Po bello, Midlothian.

J. F. FIELD,
Divisional Controlle
British Electricity House,
Portobello,
Midlothian,
17th October, 1953. E58

BRITISH EUROPEAN AIRWAYS

ORGANISATION AND METHODS BRANCH

British European Airways invite applications f POST in their recently formed Organisation Methods Branch. The person selected will responsible for the investigation and developmen office methods and accounting and other paper w systems. Applicants should have a University Deg preferably in Engineering, Science, or Mathema or a professional qualification in engineering accountancy ; some years' experience in a positio responsibility ; and recent experience of meth study. A knowledge of office machines and eq ment, including punched card equipment, is desirable. Salary within the scale £875–£1175 annum. Pensions scheme.—Applications, giving details of age, qualifications, experience, and w available, to the Chief Personnel Officer, B.E Keyline House, Ruislip, Middlesex. Closing 15th November, 1953. Persons who answered similar advertisement in July last should not re-ap E58

BRITISH ELECTRICITY AUTHORI

MIDLANDS DIVISION

ENGINEERING DRAUGHTSMAN (MECHANICAL)

ENGINEERING DRAUGHTSMAN (Mec nical) required in the Generation Construc Department at Headquarters, Birmingham. N service conditions, superannuable appointm salary according to qualifications and experie within Schedule D of the Agreement, Grade £433 to £567, or Grade 5, £567 to £671 per annum

Applicants should have received a sound techn education and practical training and should have experience in the drawing office of a large ma facturer's works engaged on turbine, boiler plan general engineering construction. Appropri technical qualifications an advantage.

Apply on Forms AE6, quoting vacancy 535MD, available from the Establishments Offi 53, Wake Green Road, Moseley, Birmingham, by 14th November, 1953. E58

ADMIRALTY

ROYAL NAVAL SCIENTIFIC SERVICE

SENIOR SCIENTIFIC OFFICER AND SCIENTIFIC OFFICER

Applications are invited for appointments SENIOR SCIENTIFIC OFFICER and SCIENTIF OFFICER Grades in Experimental Establishment London, Portsmouth, Weymouth and Glouces shire areas and Scotland. The majority of posts for Engineers and Physicists (particularly Electronics), but there are a few posts for Phys Chemists and Metallurgists. Candidates must British subjects with an appropriate First or Seco Class Honours Degree or equivalent high professio attainments. London salary inclusive of pay addi (men) S.S.O.s, £917–£1075, S.O.s, £440–£812. appointments are unestablished (with F.S.S.U.), with some opportunities to compete for establis posts.—Application forms from M.L.N.S., Techn and Scientific Register (K), 26, King Street, Lond S.W.1, quoting A 246/52/A/BH. E58

HILLINGDON HOSPITAL

ASSISTANT ENGINEER

ASSISTANT ENGINEER required, Hillingd Hospital, Hillingdon, Middx. Ordinary Natio Certificate in Mechanical Engineering or equiva qualification. Electrical experience desirable.

Salary £450 by £15 to £525 per annum, London weighting.—Applications, together names of three referees, to Group Engineer by November. E58

THE ENGINEER

OCTOBER 30, 1953

Colombo Plan

THE consultative committee for Co-operative Economic Development in South and South-East Asia (the Colombo Plan consultative committee) has recently been meeting in New Delhi. The main purpose of the session was to review progress under the Colombo Plan during 1952–53, including the achievements of countries in South and South-East Asia in their development programmes. The resources being devoted to development projects have progressively increased since 1951, although many of the projects included in the development programmes are of long-term character and the full benefits from them will not accrue for several years, the committee noted. There are already indications of considerable progress, it states, especially in agriculture, irrigation, power and transport. Some representative examples of the figures in several of the countries concerned are given below. In Ceylon, about 20,000 more acres of irrigable land were opened in 1952–53, mainly under the Gal Oya scheme, work on which continues to make satisfactory progress. The improvement of Colombo harbour was well under way, and the first stage of the hydro-electric scheme at Norton Bridge was completed, resulting in an increase in capacity of 25MW. In India, irrigation works benefited 3,500,000 acres of land during 1952–53. The Central Tractor Organisation reclaimed some 510,000 acres. Owing partly to good seasons, but also because of these and other developmental measures, the production of food increased by nearly 5,000,000 tons as compared with 1951–52. Work on a number of major water control projects was progressing satisfactorily, and power generation capacity was increased by 315MW. A fertiliser factory, the Chittaranjan locomotive factory and a telephone factory went into production. The construction of three ships was completed, and 333 new railway locomotives were commissioned; the two principal producers of iron and steel were expanding their production capacity and two oil refineries were being erected near Bombay. In the Federation of Malaya the first stage (40MW) of the Connaught Bridge power station was completed. The gap in the East Coast Railway was closed by the relaying of 200 miles of line, and in Singapore, a new power station with an interim capacity of 40MW has been brought into operation. In Sarawak progress was made with development on roads and air transport and with telecommunications. In North Borneo, schemes for irrigation, communications, electricity and housing were under way. In Nepal, the construction of 79 miles of motor road to connect Kathmandu and Bhaise was started in September, 1952. Five more important districts were connected with each other by air services. A systematic geological survey of Nepal was under way. In Pakistan, satisfactory progress was made with various multi-purpose and irrigation projects. The Lower Sind Barrage was brought to an advanced stage, and its total installed capacity was increased from 70MW to 140MW. The cotton textile industry made good progress.

British Coal Utilisation Research Association

MORE than 300 guests and members attended the annual luncheon of the British Coal Utilisation Research Association which was held in London last week. Proposing the toast of the Association, Sir Ben Lockspeiser said that this country was still the greatest coal waster in Europe, and since the beginning of this century it had lost by far the greater part of the trading advantage which came from the export of coal. The increase in coal production was not sufficient to keep pace with the country's increasing demand for fuel, and it was essential that the fullest possible use should be made of the coal available by using efficient and economic appliances. In this the Association played a very important part in promoting the development and use of coal-saving equipment. There was a considerable waste of the increasing proportion of fine coal mined, and Sir Ben drew attention to the processing method for slurry or coal mud developed by the Association. A pilot plant based on the process had been installed by the National Coal Board for burning pelleted slurry in boilers at the pithead. Sir Ben went on to say that greater use should be made by industry of the facilities of the Association for training fuel technologists, and it would be well if the industry recruited graduates for this form of specialised training. Responding to the toast, the president of the Association, Sir Charles Ellis, spoke of the steady growth of the Association and the important work it had already done to assist the coal industry. He said that the waste of fuel which persisted in domestic coal burning apparatus was a challenge to industry, and was a problem of outstanding importance by the solution of which vast amounts of valuable coal could be saved annually.

Railway Rolling Stock Production and Programmes

IN the course of the debate in the House of Commons on the fifth annual report of the British Transport Commission, the Parliamentary Secretary to the Ministry of Transport, Mr. Gurney Braithwaite, drew particular attention to the serious effect the shortage of steel had on railway programmes for new rolling stock. He said that as a result of the steel shortage in 1952 the programme of new wagons was cut by 37 per cent, of new locomotives by 50 per cent, and of new carriages by practically 100 per cent. Now, with the improvement of steel supplies, a steady build-up of production had begun, but it would take some time to make itself felt. The carriage programmes had suffered most severely, for at the beginning of this year there had been a deficit of 1545 passenger carriages to carry forward to the programmes scheduled for 1953. Only 481 passenger carriages were actually built in 1952 and 535 were expected to be completed this year. By 1954 it was estimated that the railways would build 1500 carriages—a figure approaching their total capacity. A deficit of some 12,000 freight wagons had to be added to the scheduled programme of 19,000 for 1953. Continued shortages of certain steels and the inability to work up to full production made it unlikely that more than 13,000 wagons would be built this year. Next year, however, the railways were expected to produce to their full capacity and turn out some 20,000 wagons. In connection with locomotives, 294 were scheduled for completion this year, which started with a deficit of 170 from previous programmes. It was hoped to build 233 during 1953.

Ministry of Supply Tank Factory

A FACTORY planned to produce tanks, using modern automobile conveyor assembly techniques, was officially opened last Friday for the Ministry of Supply by Mr. Duncan Sandys. The ceremony was attended by many distinguished guests of the Leyland Motor Company, which built and is to operate the factory. It occupies a 100-acre site at Leyland and was built and largely equipped in less than two years, these two operations having proceeded together. Some 11,000 tons of structural steel, 42,000,000 bricks and 203 miles of electric cable were involved in its construction. Essential power supplies can be maintained, should the grid supply fail, by its own generating plant, which consists of sixteen English Electric diesel generating sets. In the boiler-house are La Mont high-pressure oil-fired water boilers for space and process heating. A main fabrication shop has been built comprising five bays, 35ft by 600ft long, within which welding and machining of all components required to make the hull box unit proceeds, and here also is a bay housing a battery of rotary manipulators each capable of holding the largest envisaged armoured tank hull. It is possible with this equipment to present all welds for welding in the gravity position. Some of the welding rods are ¼in diameter. The cast armoured hulls and fabricated turrets then pass to the assembly shop where machining progressively proceeds up to the assembly section and thereafter each hull rests on a conveyor track for the assembly stages. A number of notable machine tools and fixtures have been designed or adapted for specific production stages. On one, a Froriep boring and facing machine with a 20ft diameter table, is mounted an "averaging" fixture within which it is possible to locate directly the turret casting thus eliminating marking out operations. Using the locations machined at this station the turrets then pass to a battery of Berthiez vertical borers which can accommodate castings up to 15 tons weight. Apart from these larger capacity machines and batteries of floor type, Gilly borers, Fellows gear cutters and other machines engaged on the turret ring mountings, which are all located in the three bays devoted to turret machining and assembly and tank assembly, there are another 1000 machine tools in the main machine shop. Machining for engine and gearbox mounting, radiator mounting, drilling for turret ring fitting and final drive assembly are all 100 per cent jigged to cater for interchangeability and service.

National Industrial Fuel Efficiency Service

IT is announced by the British Productivity Council that a non-profit-earning company, to be known as the National Industrial Fuel Efficiency Service, and which will provide increased fuel efficiency advisory services for industry, is now in course of formation. The company is being formed by the Council at the invitation of the Minister of Fuel and Power following his acceptance of the proposals of the committee which, under Sir Harry Pilkington, was set up to work out a scheme for implementing a recommendation of the Committee on National Policy for the Use of Fuel and Power Resources—the Ridley Committee. The recommendations of that committee were given by the Minister in answering a question in the House of Commons in June last, and they were briefly outlined in these columns in the issue of June 26th. The primary object of the company will be to provide general advice to industry and non-industrial establishments other than domestic users, and to give practical help to secure the most efficient and economical use of all forms of fuel, heat and power. It will take over progressively and extend the work now being done by the Ministry in that field, providing direct services or work through independent consultants. The company will receive no direct Government subsidy, but will be financed by contributions from the National Coal Board, the British Electricity Authority and the Gas Council, supplemented perhaps by voluntary contributions from industry and fees. The policy of the company will be controlled by a board of directors under the chairmanship of Sir Leslie Hollinghurst. The members of this board nominated by the British Productivity Council include Sir Patrick J. Dollan, Sir John Hacking, Sir Edward Herbert, Mr. Leslie A. W. Jenkins, Mr. E. Julian Pode, and Mr. Jack Tanner.

Hydro-Electric Development in Portugal

No. I—RIVER ZEZERE SCHEME: CASTELO DO BODE POWER STATION

The generating stations at Castelo do Bode on the River Zezere and at Vila Nova on the River Cavado are among the more important hydro-electric developments recently started in Portugal. The Castelo do Bode station is equipped with three generating sets with a total output rating of 172·2MVA, and a description of the plant and equipment is given here.

PORTUGAL possesses few natural resources, and the steady advancement in industrialisation, since the end of the world war, of what is still predominantly an agricultural country is, therefore, all the more remarkable. Like other Western nations Portugal was hampered by financial difficulties after the war, but much progress has been made. The Government recognised that without greater industrialisation little could be done to raise the general standard of living, and that cheap and abundant power was essential for the establishment of basic industries. Although deficient in coal Portugal is fortunate in her rivers, which provide a vast potential power, and some ten years ago an ambitious plan of hydro-electric development was prepared. Shortage of gold reserves and foreign currency have delayed some of the works, but despite these handicaps much has been done with available resources, and British engineers and manufacturing facilities have been able to play a useful part.

In 1944 two laws were enacted by the Portuguese Government, one concerned with the reorganisation of industrial development and the other with the electrification of the country. In 1945 three companies were created, namely, the Hidro-Electrica do Zezere, the Hidro-Electrica do Cavado, and the Companhia Nacional de Electricidade—the first two to produce electrical energy in the central and northern parts of the country respectively, and the third to transmit this energy to the centres of demand. Because of the important part which these enterprises were destined to play in the national economy, the government participated substantially in their finance and administration, but complete nationalisation was avoided and the companies retained their private standing.

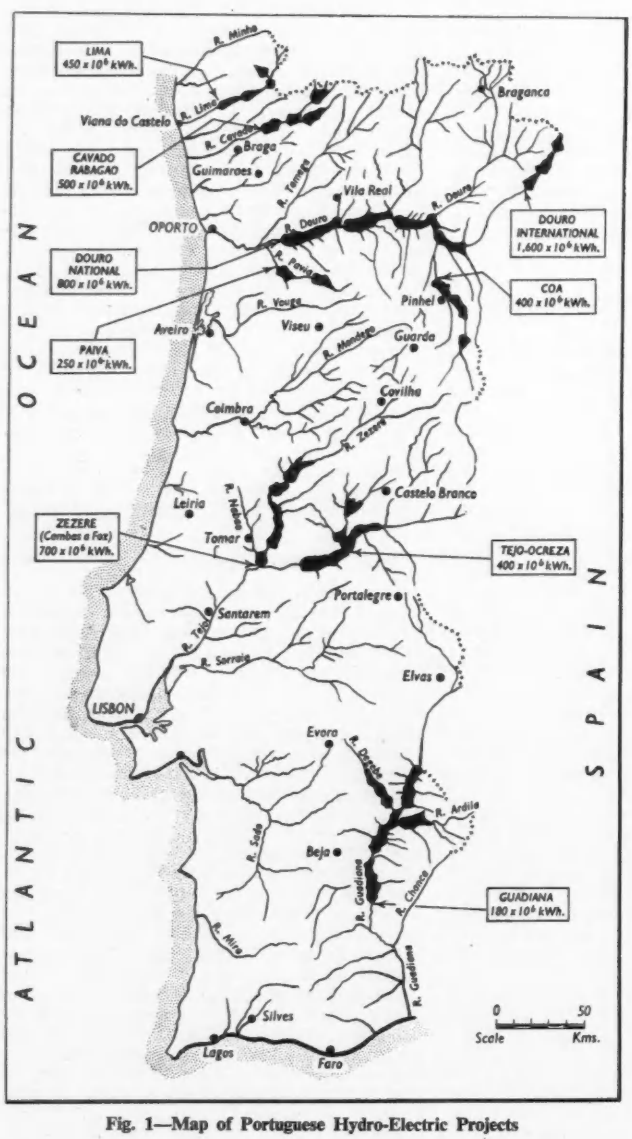


Fig. 1—Map of Portuguese Hydro-Electric Projects

Before the formation of these undertakings, two British companies, the English Electric Export and Trading Company, Ltd., and Metropolitan-Vickers Electrical Export Company, Ltd., acting together, sent an engineering mission to Portugal to confer with the Portuguese engineers who had been appointed to study various hydro-electric projects. These two companies became known in Portugal as the "British Group."

The engineering mission collected sufficient data to enable it in 1945 to put forward comprehensive proposals for developing the available water power and, in 1946, after further discussions, the newly-formed Portuguese power companies placed contracts with the "British Group" for the supply and erection of hydraulic and electrical plant and equipment for the generating stations at Castelo do Bode on the River Zezere and at Vila Nova on the River Cavado. At a later date a contract was placed with the same group by the Companhia Nacional de Electricidade for the substation at Castelo do Bode, known as the Zezere substation.

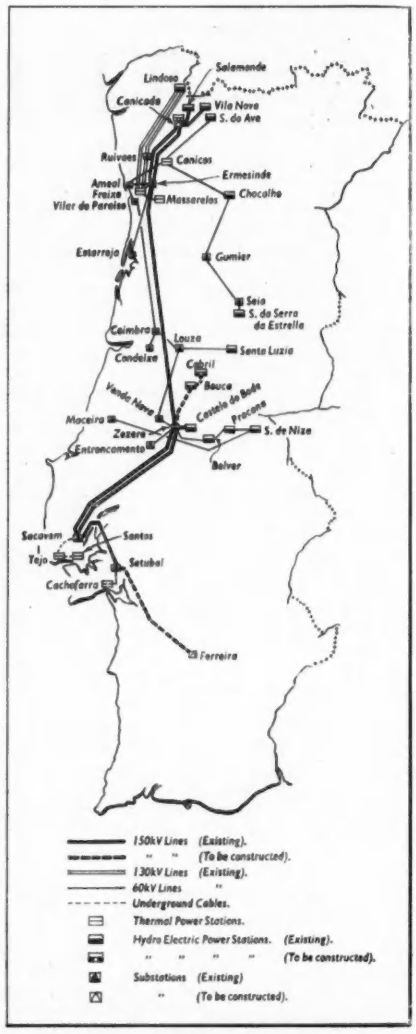


Fig. 2—Distribution System

In Fig. 1 we show the Zezere and Cavado rivers, together with various other hydro-electric projects included in the original plan, some of which are now under construction, and Fig. 2 shows the network of power stations, substations and transmission lines.

River Zezere Power Scheme

Because of its central geographical position, high rainfall and other favourable conditions, the River Zezere was chosen initially as the principal source for the development of hydro-electric power and the focal point of the national electric network. The concession granted to the Zezere company comprised the lower course of the river above its junction with the Tagus, having a length of about 140km (87 miles), and a fall over that length of 275m (904ft).

The complete scheme, which is multi-purpose in character, includes the building of dams and the formation of large storage reservoirs which, besides their purely hydro-electric function, will control the present irregular flow of the river, assist irrigation, prevent flood damage, and improve navigation.

The scheme is being carried out in three steps or stages as shown in the river plan and profile in Fig. 3, and Table I gives the more important characteristics.

The first and third of the above schemes,

namely, Cabril and Castelo do Bode, were selected for the earliest development, and of these two, it was decided to proceed first with Castelo do Bode, owing to the necessity of forming a large reservoir as quickly as possible for securing maximum regulation of the river. The Castelo do Bode dam is one of the largest of its kind in Europe and the storage capacity of the reservoir is only surpassed in the U.S.A. Incorporated in the dam is another important civil engineering work, the flood spillway, designed to deal with a discharge of 4100 cubic metres (144,790 cubic feet) per second. The power station is equipped with three generating units having a rated total output of 172·2MVA.

The development at Cabril followed a few years later than Castelo do Bode, and the contract for the power station plant and equipment was again placed with the same "British Group." Under a new construction plan approved by the Portuguese Government it is now proposed to proceed with the Bouca project, which figures second in Table I.

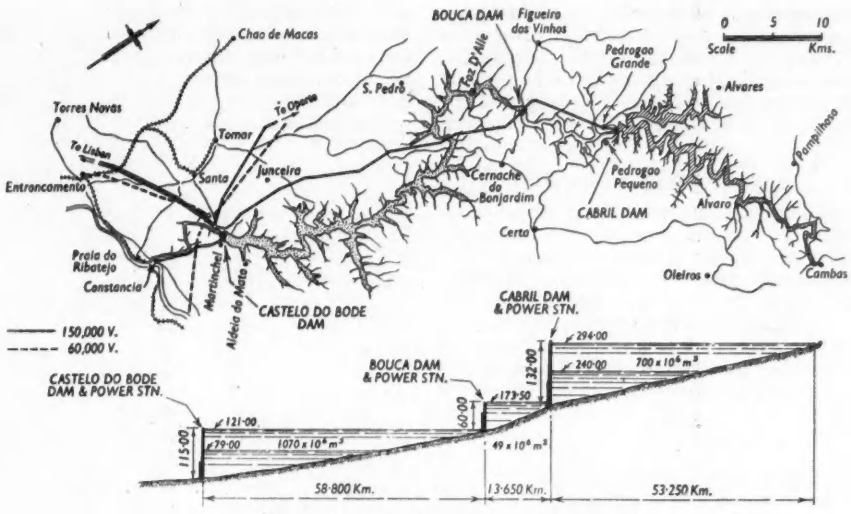


Fig. 3—Plan and Profile of River Zezere Development

River Cavado Power Scheme

As already stated, the other scheme for which a contract was placed in 1946 with the "British Group" for plant and equipment was on the River Cavado in the northern part of the country. This river flows into the sea about 30 miles north of Oporto and some 40 miles from its mouth it is joined by a tributary, the River Rabagao, across which a dam has been built; the reservoir so formed is known as Venda Nova. Water from the reservoir flows through a tunnel and pipeline to the power station at Vila Nova, where it is discharged into the River Cavado. The power station has been equipped with three generating units having a total capacity of 96MVA, and provision has been made for the installation of a fourth unit when another dam has been built on the River Cavado, upstream of Vila Nova, at Paradela. It is of interest to note here that this extension was approved by the Portuguese Government last year in the same development plan that included the Bouca project on the River Zezere. The installed capacity at Vila Nova will then be 156MVA.

Table I—*River Zezere Power Scheme*

Project	Height of dam		Capacity of reservoir		Average head		Installed capacity		Average annual output kWh × 10⁶
	Metres	Feet	m³ × 10⁶	Acre-feet	Metres	Feet	No. of units	MVA each	
Cabril	132	433	700	567,000	108	354	2	61	190
Bouca	60	197	49	39,700	54	177	2	28	110
Castelo do Bode ...	115	377	1,070	867,500	80	262	3	57·4	380

The chief characteristics of the River Cavado development are given in Table II on page 548.

The Salamonde project is now operating, Canicada is under construction, and Paradela is included in the new construction plan.

The first and largest of the hydro-electric schemes was inaugurated on January 21, 1951, when the then President of the Portuguese Republic, Marshal Carmona, opened the hydro-electric power station at Castelo do Bode. A few months later, on June 10th, Dr. Costa Leite, Minister of the Presidency,

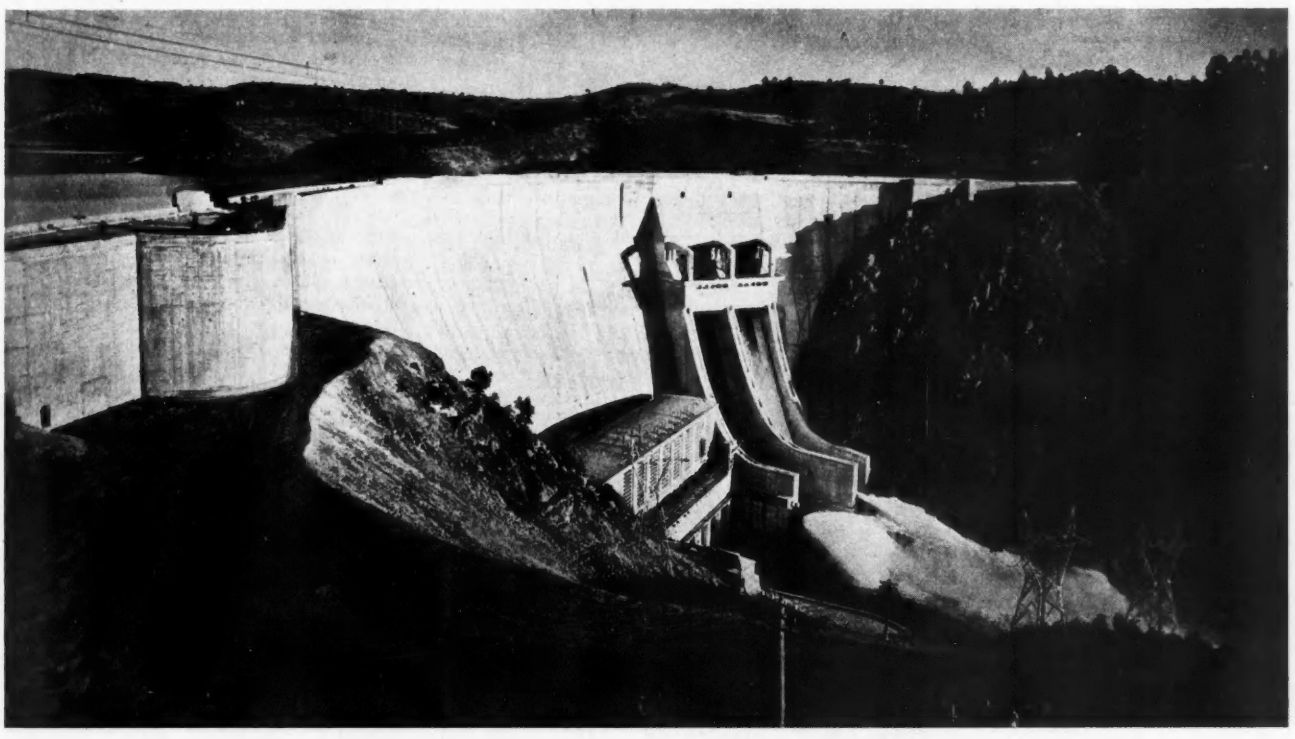


Fig. 4—Dam and Power Station with Disperser Valve and Spillway Discharging

representing the President, opened the hydro-electric power station at Vila Nova. The substations constructed by Companhia Nacional de Electricidade, including that at Zezere, were formally inaugurated by the succeeding President, General Lopes, in July, 1952.

Castelo do Bode Power Station

Arrangement at Site.—The principal works at Castelo do Bode, namely, the dam, spillway and power station building, are very compact in their layout, which has simplified construction and promoted economy. The dam, which is of the arch type, was designed to suit the local topographic conditions and it is combined with an artificial abutment of some magnitude on the right bank. The spillway is situated on the dam near the left bank and is quite independent of the power station building. Forced discharge through two large openings was adopted, after it had been found by test that free discharge was impracticable. Regulation of the flow is effected by two sector gates at the outlet of the discharge openings.

The power station was built at the foot of the dam and is in three main sections: first, the machine hall containing the generating units; secondly, an annexe between machine hall and dam in which there are housed the control gear, various essential services and the administrative offices, and thirdly, a platform downstream of the machine hall carrying the main transformers and the artificial test loading equipment.

Table II—*River Cavado Power Scheme*

Project	Height of dam		Length of pipeline and tunnel		Capacity of reservoir		Maximum gross head		Installed capacity	Firm annual output
	Metres	Feet	Km	Miles	$m^3 \times 10^6$	Acre-feet	Metres	Feet	MVA	kWh × 10^6
Venda Nova	97	319	3·5	2·06	92	74,700	414	1,360	3×32	200
Salamonde	75	246	2·1	1·31	55	44,700	127	417	2×25	200
Canicada...	76	249	7·8	4·85	138	112,000	121	397	2×32	260
Paradela	105	345	10·6	6·6	140	113,000	449	1,475	1×60	260

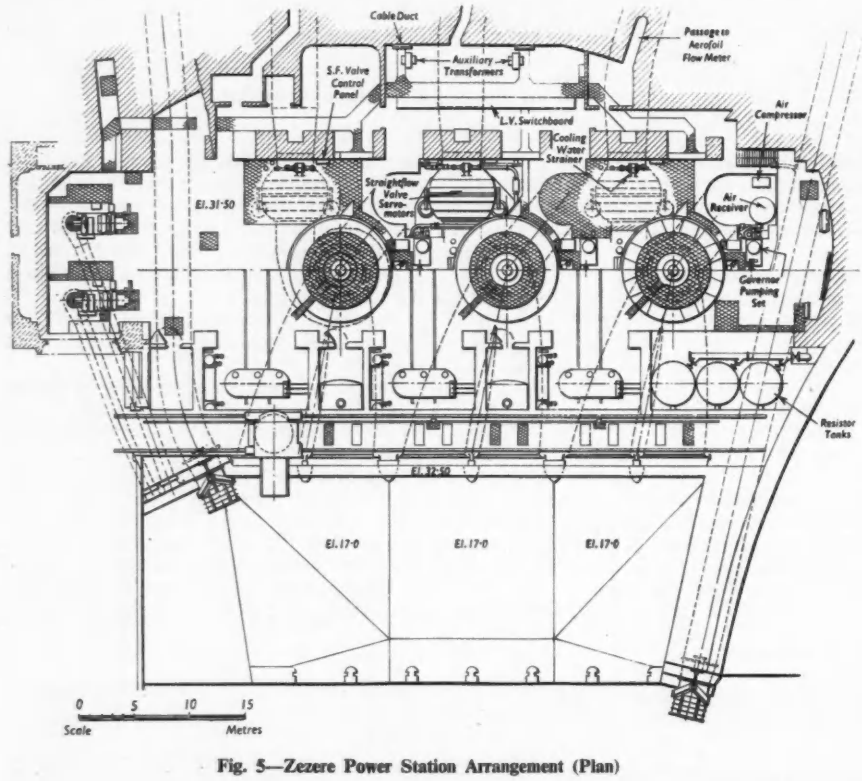


Fig. 5—Zezere Power Station Arrangement (Plan)

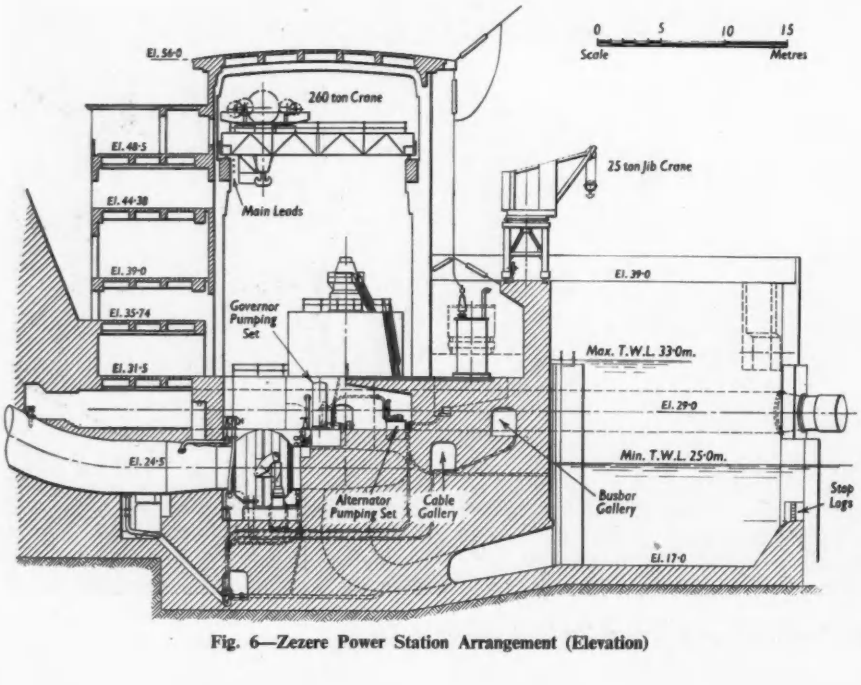


Fig. 6—Zezere Power Station Arrangement (Elevation)

The penstocks for the main and auxiliary turbines are embedded in the dam structure and their intakes on the dam face are provided with detritus screens. Protection is given at the upstream ends of the main penstocks by caterpillar type sluice gates.

Scour Culverts.—There are two 3m diameter (9ft 11in) scour culverts, one on each side of the three machines. They pass through the dam and the power station foundation and terminate in 2·6m (8ft 6in) diameter disperser valves, each capable of discharging 150 cubic metres (150 tons) of water per second under a head of 95m (312ft). The design of the valves is such that the energy of this very heavy discharge is dissipated by converting the solid jet into a hollow cone, thus avoiding erosion of the banks of the narrow gorge and the river bed. The valves are arranged for hand and electrical operation by remote control.

Arrangement of Power House.—The machine hall is on a single floor which renders every part of the plant easily accessible and enables all parts to be readily handled by the main crane. In the machine hall are the main generating sets and, next to each set, are the governor actuator with its servomotors, oil pumping set and oil pressure receiver, the bearing coolers, the generator oil pumping, set the field suppression cubicle and the gauge panel. At convenient positions are the air compressor equipment for operation of the generator brakes, the compressor set for lowering the level of the water in the draught tubes when the generators are operating as synchronous condensers, and a sump containing two pumps for dewatering the turbine draught tubes and two drainage pumps.

The three 3·35m (11ft 0in) bore "Straight Flow" inlet valves for the main turbines are placed beneath the floor level and connect the penstocks with the inlets of the turbine spiral casings. They are readily accessible to the main crane by the removal of chequer plating.

In the annexe upstream of the machine hall is a control gallery which overlooks the generating plant and, beneath it, the cable gallery, workshop and stores and the low tension switchgear for the a.c. and d.c. auxiliary services. On the platform downstream of the machine hall are the three main transformers with their oil cooling equipment and the two oil reservoirs, each containing sufficient oil for one transformer. On the same platform are the three water resistances of the artificial loading equipment used for testing purposes and, at its

Fig. 7—Interior of Power Station Showing Three 73,000 H.P. Generating Sets

downstream end, a wall has been built for protection against flooding due to abnormal rise in water level. Upon it runs a 25-ton jib crane for handling the draught tube gates and the parts of the disperser valves. Beneath the platform there are two galleries housing the 15kV busbars and the control cables. Copper connections are taken from the 165kV terminals of the main transformers to the roof of the power station and thence by short overhead lines to the Zezere substation. This is situated on a plateau about 800m from the power station.

Drawings showing the power station in plan and part section, respectively, are shown in Figs. 5 and 6. Fig. 4 shows the dam and power station with the spillway and one of the disperser valves discharging simultaneously. The 165kV overhead lines from the station roof to the Zezere substation can also be seen in this photograph. A view of the interior of the power station is reproduced in Fig. 7.

(To be continued)

Iron and Steel Institute in Holland

No. III—(*Concluded from page 524, Oct. 23rd*)

From September 30th to October 7th the members of the Iron and Steel Institute paid a visit to Holland. Their activities are described and mention is made of a number of the works they visited.

ON Saturday, October 3rd, members of the Institute visited the works of Koninklijke Nederlandsche Staalfabrieken v.h. J. M. de Muinck Keizer N.V. The name commemorates the fact that the company was founded by Mr. Muinck Keizer, who in 1902 was the first to make steel castings in the Netherlands. The title is, however, something of a mouthful and the firm is more usually referred to as "Demka," a word it has adopted as a trademark. The works are situated just outside Utrecht, alongside the great Merwede canal, which runs from Amsterdam to the Rhine and which can carry barges of several thousand tons. Much of the raw material is brought to the site by water and there is a well-equipped harbour capable of berthing barges up to 3000 tons capacity. The older part of the works lies on the eastern bank of the canal. But much ground has now been acquired on the other bank and new shops have been and are being built on that bank. Members were conveyed across the river on a well-fitted diesel-driven water excursion craft, upon which morning coffee was taken. It is an illustration of the weight of floating traffic on the canals that it had to await its opportunity to cross, just as a car turning right in this country may need to await a gap in road traffic flow.

The older works is far from modern. But the firm aims to produce high-quality materials rather than high output. Steel castings, for example, are produced in a wide variety of alloys, such as manganese steel, molybdenum steel, nickel steel, chromium steel, chromium-nickel and chromium-molybdenum steels. Some of the castings are very large in size. For marine purposes, for instance, stern frames, stems, rudder frames and propellers are cast. Smaller castings up to 650 lb in weight, if the order is large enough, are moulded on a range of moulding machines.

For the purpose of producing the range of special steels required the works are equipped with two oil-fired open-hearth 30-ton furnaces, four electric arc furnaces with capacities of 25, 10, 8 and 4 tons respectively, and a high-frequency induction melting furnace of 500 kg capacity. Ingots for forging up to 50 tons in weight are produced in various grades. The rolling mills have not been modernised since the war, and at the finishing mill members were able to admire the dexterity of operators, who catch with tongs the end of the rod as it emerges from one stand and insert it between the rolls of the next. There is a blooming mill capable of taking ingots up to 1100 lb in weight. It is a three-stand, three-high, 24in mill. The second stand delivers square billets for re-rolling and the third rolls rounds. The merchant mill includes a four-stand roughing mill, 12in roll diameter, and a seven-stand finishing mill of 12in roll diameter. A 140ft cooling bed with rotary hot shears and cold shear line and three wire reels form the finishing part of the mill. Members were able also to see hot-rolled products further processed in the drawing, turning and polishing section.

Perhaps the most interesting part of the visit was that to the new shops on the west side of the canal. The photograph reproduced in Fig. 11 shows a hammer of 3000 kg drop weight in operation in the forge and the use of a modern electrically operated manipulator. There are six forging hammers, the largest being a drop weight of 6500 lb. The forge (and the works generally) is equipped to carry out any form of heat-treatment that may be required.

Following upon this visit the members lunched in Utrecht and the afternoon was spent in making an excursion for tea at Laren.

On Sunday, October 4th, many members and their ladies made an excursion to Volendam and the island of Marken, in the Zuyder Zee. For ourselves we preferred to see more of the city of Amsterdam.

Monday, October 5th, proved a somewhat disappointing day. It was planned that members should visit Delft in the morning, spending part of the time in the laboratories of the Technical University there or at the National Testing Institute and the rest of the time touring the city under the guidance of students and others from the University. But unfortunately there was a delay in starting out from Amsterdam, with the result that the proceedings had to be telescoped. No opportunity became available adequately to see the city and the visit to the Testing Institute, which we attended, was both too crowded and too rapid for an adequate conception to be gained of the work going on. We hope that a renewed opportunity to learn more about the undoubtedly very valuable and interesting work going on will present itself at some future date.

Nor unfortunately, after this bad start, was there really adequate time available to have a look at The Hague, as planned for the afternoon. But members were able to visit the Mauritshuis and admire there a very fine collection mainly of Dutch paintings.

In the evening there was a reception with supper and dancing at the Carlton restaurant in Amsterdam.

On the final day of the meeting, Tuesday, October 6th, the members travelled by special train to Rotterdam. Upon arrival there a coach tour was made of the city. One of the first acts of the Germans when they invaded Holland in 1940 was to make a low-level mass bombing attack on Rotterdam. The whole centre of the city was destroyed. Since the war the Dutch have cleared the whole area affected and have begun to rebuild. There is, in fact, in course of creation a really modern city, whose highways will be adequately wide to carry modern traffic and in whose buildings modern methods of construction are being used. Architects are being given the opportunity to adopt new instead of traditional designs. Already a number of shopping stores have been erected, together with office buildings for banks and corporations; and there is a central wholesalers' building with internal roads giving access to three floors. Through the very heart of the new city there runs the great double-track road leading to the Meuse tunnel, built shortly before the war; and, again in the heart of the city, a helicopter landing ground has been laid out, from which regular services are available to Brussels.

After this very interesting tour the members boarded two vessels, toured Rotterdam harbour and docks, and proceeded up-river to Alblasserdam, taking lunch on the way. Alblasserdam is situated on the River Noorp between Rotterdam and Dordrecht, and that river carries practically all the traffic between Rotterdam and Germany. It is navigable by ocean-going vessels and along its banks there are many shipbuilding yards and ship-breaking yards. This, on account of the ease of access by water and the availability

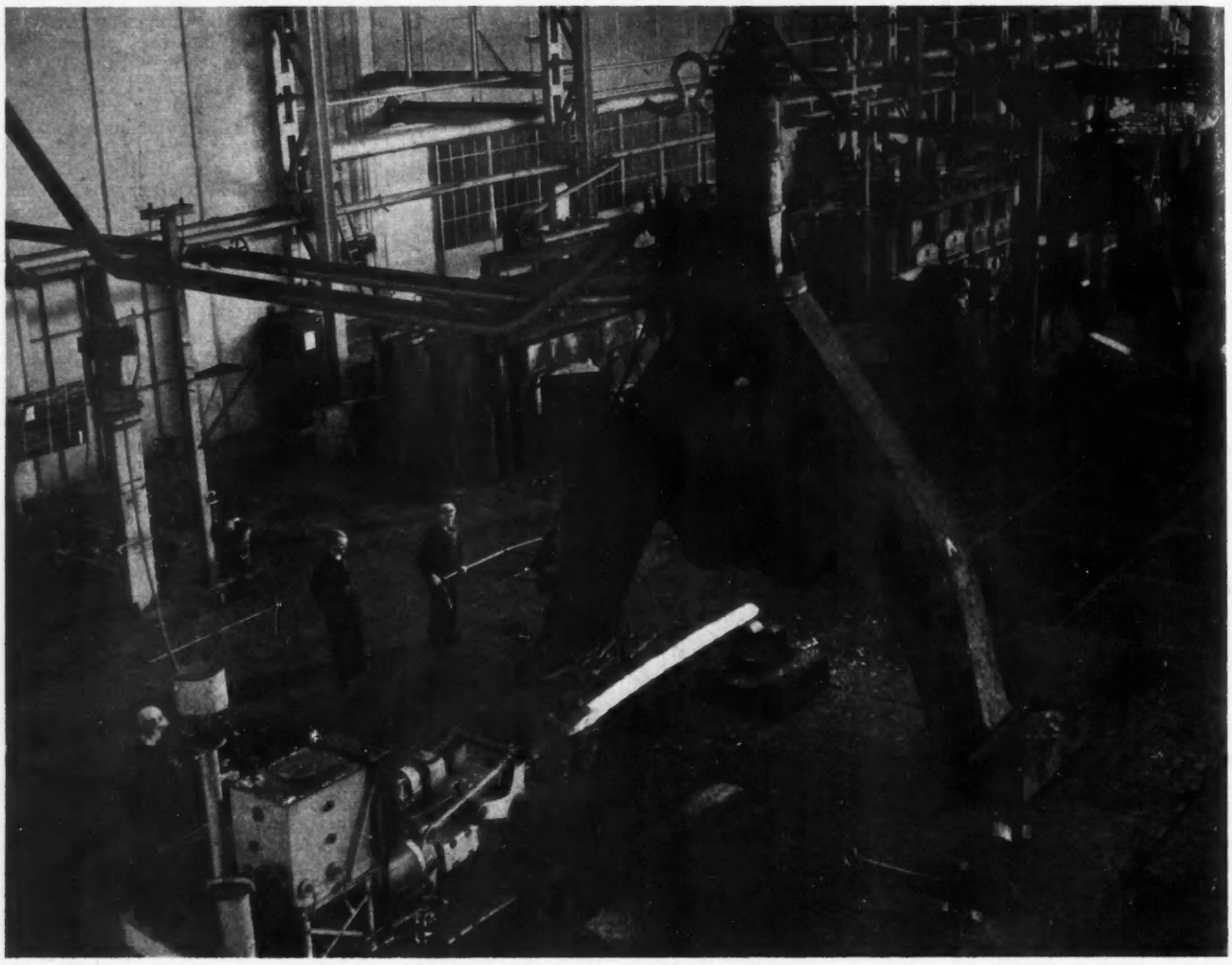


Fig. 11—Forging Hammer in Demka Works

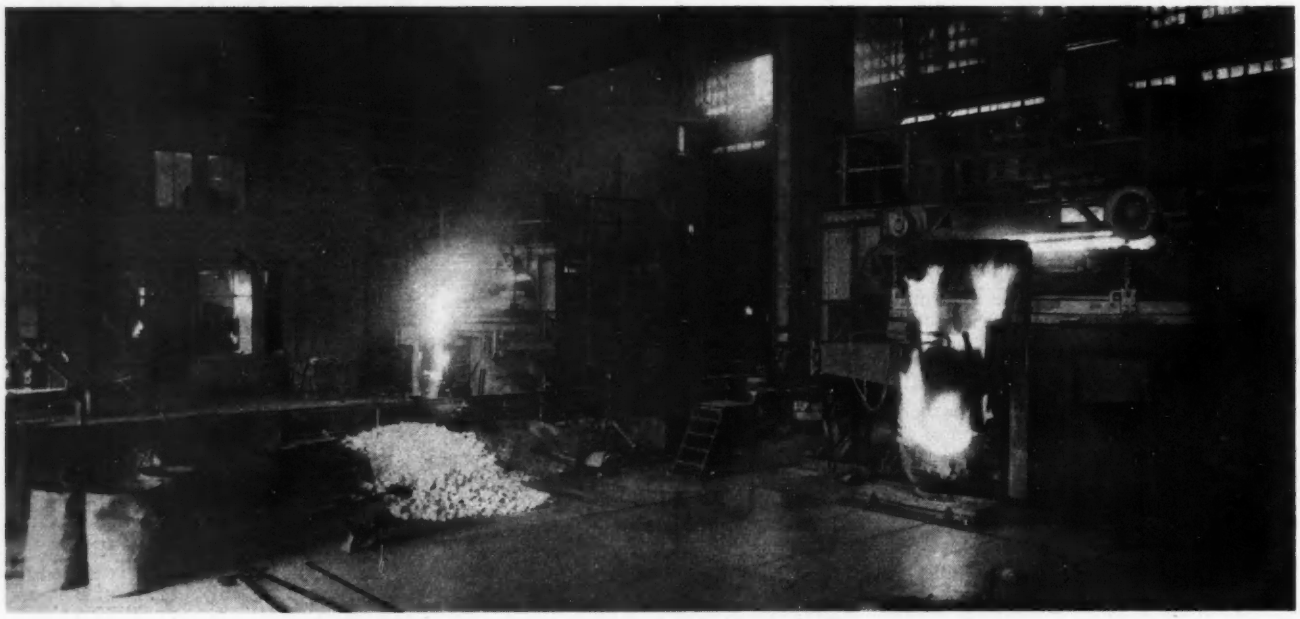


Fig. 12—Electric Furnace Plant at Nederlandsche Kabelfabriek

of power, was the site chosen by N.V. Nederlandsche Kabelfabriek when it was felt desirable, in 1937, to establish a steel plant with rolling mills, &c., to produce narrow hot and cold-rolled strip and galvanised round and flat steel wire for use in the cable making works that had existed in Delft since 1913. This was the plant visited by a majority of members in the afternoon. The remainder went to Rotterdamsche Droogdok Maatschappij.

We observed nothing of peculiarly striking interest in the melting shop of the Kabelfabriek steel works, except that one of the three 35-ton open-hearth furnaces has been converted to all-basic oil-fired operation. The other two are also due to be so converted. In addition to these three furnaces there are two 25/30-ton electric arc furnaces of about 8000kVA rating (Fig. 12), and the total yearly capacity of the plant is expected, after conversion of the two remaining furnaces, to reach 200,000 tons. At the moment two sizes of ingot are formed, weighing 360 lb and 1100 lb respectively. But a new continuous billet and slab mill having just come into operation, for which the heavier ingots are suitable, smaller ingots will soon cease to be made to suit the old mill the new one replaces. The larger ingots are bottom cast normally in sets of twelve.

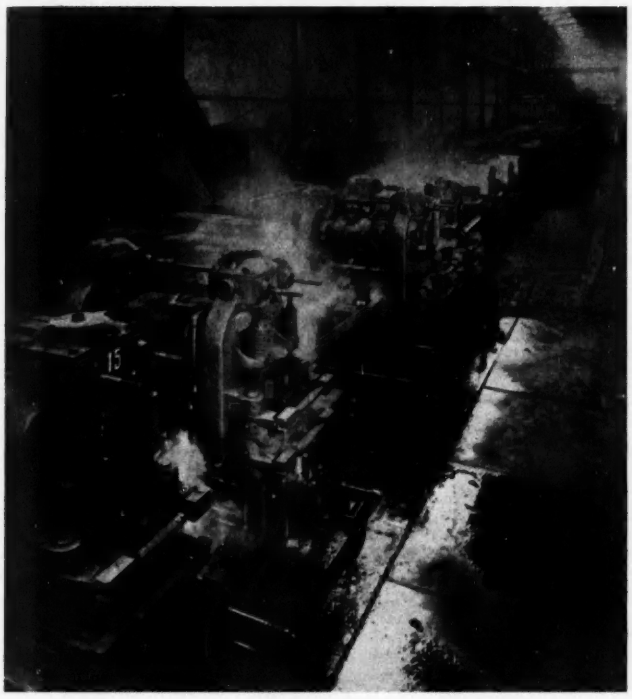


Fig. 13—Wire Rod Mill at Nederlandsche Kabelfabriek

The continuous billet mill is of unusual design. Ingots drop out of a 30-ton reheating furnace on to a roller table leading to the six-stand mill. Twisting between the stands is done automatically without stopping the ingot. After these six passes the bar drops on to a roller table, which carries it back under the main drive spindles, and it is tilted on to the original roller table, cropped by a 300-ton shear and given another four or six passes in the same stands. The finishing speed is 600ft per minute. A second 300-ton shear operates and the billet or slab runs out on to a cooling bed.

The continuous strip mill is of less interest, as, apart from a few additions, it is the plant originally installed in 1938. It normally produces strip from 1½in to 4in wide. But the continuous rod mill has a number of points of special interest.

Bundles of billets, 30ft long, are deposited on a moving-beam separating table, at the bottom end of which they are fed, two or three at a time, into the 30/45-ton two-zone oil-fired billet heating furnace. A furnace cross pusher feeds the billets into the roughing train of the three-stand mill, which consists of eleven stands of sizes, 18in, 16in and 14in, driven by six 900 h.p. d.c. motors ; three flying shears cut off heads and tails automatically, and the bars then enter four 12in continuous and two 12in looping stands of the intermediate train, driven by another set of six 900 h.p. motors ; finally the bars run via an S-shaped repeater to the six-stand 10in finishing train powered by a 2000 h.p. motor. The finishing speed is up to 5000ft per minute for No. 5 rod. There are five coilers under the floor and a cellar containing the pressure lubricating equipment for the roll necks, the gears and pinions of the finishing stands, and the reduction gears of the strip mill. A conveyor belt and a hook carrier 2000ft long, complete the mechanical equipment of this mill.

Electrically there are some points of special interest. The twelve 900 h.p. motors and the 2000 h.p. motor receive their current from pumpless air-cooled mercury arc rectifiers, which in turn are fed by fourteen separate transformers. The speed regulation is adjusted from two control pulpits, which are in telephonic communication with each other and also with the motor room and the mill foreman. Speeds can be adjusted within the narrowest limits. Between no load and full load at any set number of revolutions the maximum steady-state speed drop is 0·1 per cent and the time of the impact speed drop is 0·1 sec. maximum. This has been made possible by a completely electronic speed control, developed by the electrical staffs of the works and the mill builders.

The air of the rectifier bay and of the motor room is independently circulated, cleaned and cooled by two sets of 110 h.p. equipment. Under the motor room floor is located the central oil lubricating system for the six reduction gears of the eleven roughing stands and for the pinion stands of the roughing and intermediate trains. The cellars have the same area as the motor room, viz. 14,000 square feet. They are linked by underground passages with the cellars under the billet mill and the boiler and compressor rooms and with the pump house near the river, which is capable of supplying the plant with about 10,000 gallons per minute of water.

The hot mill building, in which some of the rods and all the hot finished strip are stored, is about 1500ft long and 125ft wide. Over a length of 1250ft there are no centre columns. Two parallel overhead crane routes of 60ft span, each carrying three 15-ton or 7½-ton cranes, are supported in the middle of the bay by a structure hanging from the roof. The end of the hook conveyor is also attached to this structure in such a way that the hooks can be off-loaded towards either of the crane routes. Adjacent to the mill bay are the roll turning and grinding shops, the mechanical and electrical maintenance shops and the spares storage rooms. Part of the mill is illustrated in Fig. 13.

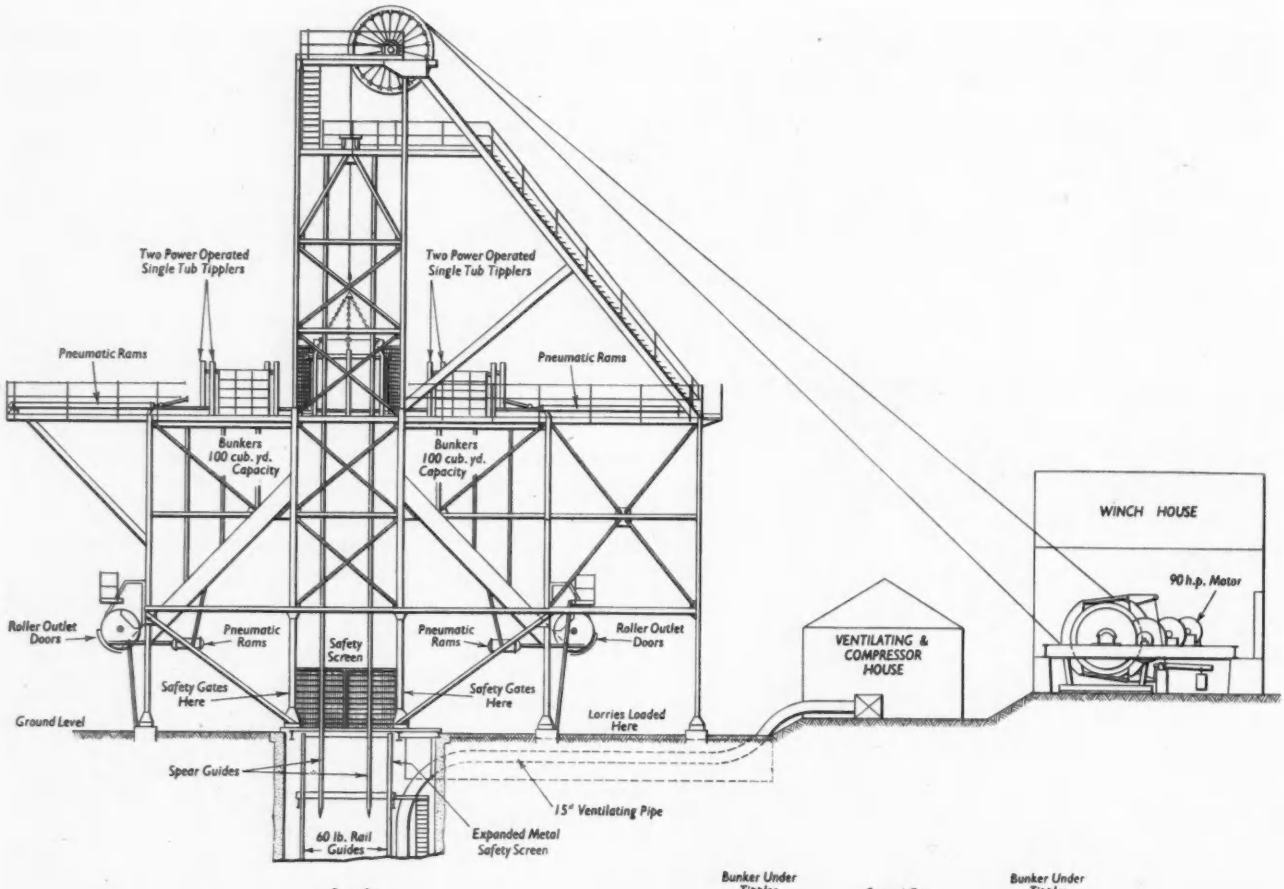
In the evening a dinner was held at the Atlanta Hotel in Rotterdam. A number of speeches were made ; thanks were appropriately given for the hospitality received and as appropriately responded to. For this was the farewell occasion, and as soon as the speeches were over a number of the members who intended to return to England by the night service from the Hook of Holland had to leave. Of the remainder some stayed the night at the Atlanta Hotel, some returned to Amsterdam. A very successful " Special Meeting in the Netherlands " had come to an end.

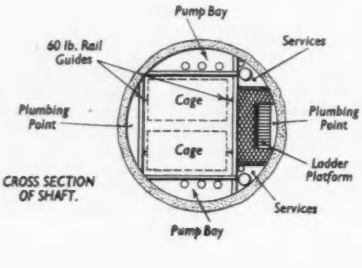
Grouting of Railway Embankments

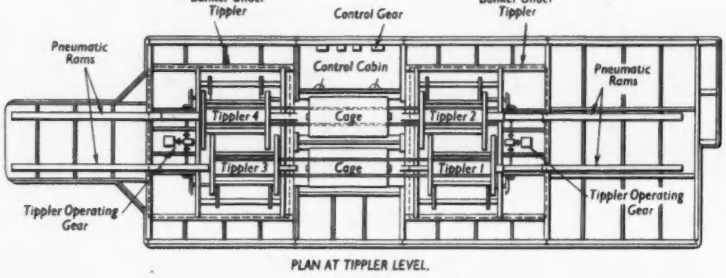
WHERE railway embankments have been constructed of fissured clay inadequately consolidated, they are prone to suffer from slips and continuous deformations over many years. Large-scale trials have been undertaken by British Railways, Western Region, on a long embankment of this kind between Banbury and Leamington Spa and near Fenny Compton Station, by the injection under pressure of neat cement water grout to effect stabilisation. This method differs from that known as " track grouting," inasmuch as the grout is introduced at a much deeper level of the order of 15ft to 17ft below track level and at higher pressure. Difficulties originally experienced were mainly due to grout working its way upwards round the outer periphery of the tubes used for its introduction into the embankment. To overcome this tendency a " grouting point " was developed. This grouting point was described in our issue of June 26th last, as part of the account of the civil engineering models displayed at the Institution of Civil Engineers' conversazione. While the grouting point is being driven to the required depth the slots through which the grout emerges remain covered and clear of the soil which might otherwise clog them. When that depth has been reached a bar is introduced within the point and the forward nose of the grouting point is driven further into the soil, thus uncovering the slots. A large collar provided at the upper part of the grouting point not only enables the point to be attached to the tubes, but also creates a wedge of soil, which acts as a seal and prevents the flow of grout upwards as previously mentioned. The grout is injected by a pump direct to the grouting points without the use of a compressor. The points are driven by a simple hand-operated pile driving frame and can, of course, be extracted and used again. The acceptance of grout is of the order of 18 cwt of neat cement.

The work, which so far has involved the driving of approximately 1500 points, has been successful in so far as the speed restriction on traffic on this embankment previously existent throughout the year has been removed and the constant attention and fettling of the track have been greatly reduced ; the only attention required, in fact, is that of slight occasional lifting due to the continuous consolidation of ashes which were tipped in places where slips had occurred. The cost per lineal foot of track is about £8, excluding the purchase price of the plant, compared with some £50 where counterforting was resorted to.

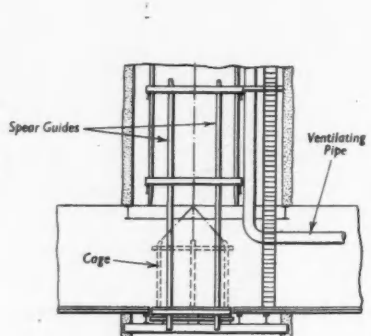
MARINE ENGINEBUILDERS.—At the annual general meeting of the National Association of Marine Engine-builders, held in Edinburgh on October 21st, Mr. Ewen H. Smith, the chairman and managing director of David Rowan and Co., Ltd., was elected chairman and Mr. P. L. Jones, M.C., a director of Swan, Hunter and Wigham Richardson, was made vice-chairman.

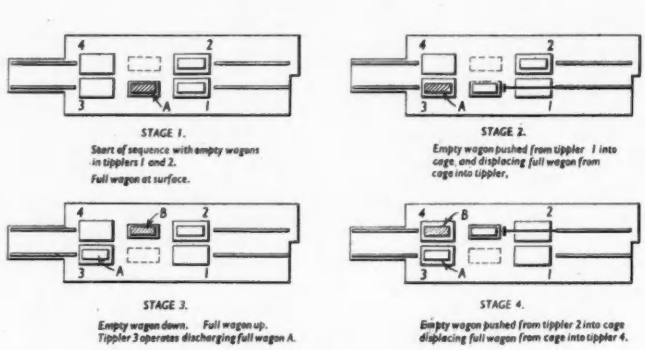






PLAN AT TIPPLER LEVEL.




STAGE 1.
Start of sequence with empty wagons in tipplers 1 and 2.
Full wagon at surface.
STAGE 2.
Empty wagon pushed from tippler 1 into cage, and displacing full wagon from cage into tippler.
STAGE 3.
Empty wagon down. Full wagon up.
Tippler 3 operates discharging full wagon A.
STAGE 4.
Empty wagon pushed from tippler 2 into cage displacing full wagon from cage into tippler 4.
STAGE 5.
Empty wagon down. Full wagon up.
Tippler 4 operates discharging full wagon B. Sequence continues.
NOTE:- Only one sequence shown.

General Arrangement of Automatic Headgear for Tunnelling

Automatic Headgear for Tunnel Driving

By O. DAWSON AND A. S. BERTLIN

Automatic headgear installed for the construction of the Haslingden and Walmersley tunnels of the Haweswater Aqueduct is described hereunder. It is thought that such automatic gear, although common in the mining industry, is an innovation for civil engineering work. The headgear is installed at three shafts.

THE Haslingden and Walmersley tunnels form part of the Haweswater Aqueduct, a major engineering undertaking that is being built to convey water from the Haweswater reservoir in the Lake District to Manchester. The two tunnels total over 11 miles in length, and are the most southerly of the aqueduct, which is itself over 80 miles long.

The tunnels were driven from three portals and three shafts. The ground through which they were driven consists of typical coal measures with nearly horizontal beds of shale and sandstone. The three shafts were used for spoil-winding during the driving of the tunnels ; they are now being used for access during the lining and will be filled in when the tunnels are complete. Each shaft is 17ft in diameter inside a concrete lining, while each tunnel is driven to a horseshoe cross-section with an approximate diameter to the ground of 11ft.

In order to provide ample winding facilities for the muck from the driving of the tunnels, it was decided to install headgears with bunkers at each of the shafts. As progress in driving the tunnels exceeded the original expectations, the winding capacity of the headgears was, at times, fully employed. The repeated winding of wagons in cages, unloading them and returning them empty to the shaft bottom suggested the use of automatic handling at the bunker level. Although automatic handling of wagons is common in the mining industry, its application to temporary civil engineering constructional work is thought to be unique.

Although the three shafts are of different depths it was decided that the three headgears should be identical as regards construction, method of operation and speed. This saved initial cost and had the advantage that all working parts were interchangeable, thus obviating the necessity of stocking large quantities of different spares. Only a limited time was available between the inception of the scheme and the scheduled full working of the headgears, but fortunately manufacturers were found who would give a promise of delivery to fit in with this time. First of all the precise duty of a headgear had to be decided and the next section of this article deals with the designer's problems, while the following section covers the operation of the headgears at site.

Duty.—As the shafts were not very deep (varying from 150ft to over 350ft, including sumps), winding speeds could not be very high and were standardised at 240ft per minute. The size of the wagons was controlled by the conditions in the tunnel, as the width of the latter did not allow room for more than two 2ft gauge tracks to be laid side by side.

The wagons were loaded by Eimco 21 loaders and this limited to some extent the length of the wagons, while their width was governed by the clearances allowed for passing. The track had to be laid under difficult conditions and was not therefore up to railway standards. If a derailment took place the wagons had to be lifted and levered on to the track by manpower, so that their weight could not be excessive. All these factors were taken into account when a wagon size of 40 cubic feet was selected.

Tippler wagons were chosen, as they have a low centre of gravity and a low loading height. Estimated tunnelling progress suggested that it would be necessary to handle up to twenty wagons per hour. Two cages in balance, with a cycle time of 2 minutes would give a margin for winding material. It can be seen from these figures that there was little time to spare for delays. The deep shaft, with a winding time of 1½ minutes had a cycle time of 2½ minutes, which left even less time for delays.

One minute decking time is not very long for unloading and loading the cage, and as this operation had to take place simultaneously at both the top and bottom of the shaft, there were two opportunities for delay. In order to reduce one delay possibility it was decided to mechanise the whole of the top handling equipment so that the speed of working was controlled by the bottom handling. Mechanisation of the top handling gear made it possible to have all the top handling controls in a central control cabin situated at bunker level.

As the winding of spoil had to be carried out during each of three 8-hour shifts every day, it was necessary to provide bunker storage sufficient for at least one shift's work. The total capacity of the bunkers was, therefore, specified to be 200 cubic yards at each shaft.

The bunkers had to be discharged into lorries, and in order to reduce the time of loading the former were fitted with large arc gates. Each gate was worked by an air ram under the control of the lorry driver, who was made responsible for loading his own lorry.

Method of Operation.—Each headgear is equipped with two cages, these being connected by 1in diameter locked coil wire ropes to a 9ft diameter winding drum, so that one cage ascends whilst the other descends as shown in the side elevation of the shaft in the illustration herewith. The maximum out-of-balance load which can be carried by either cage is 4 tons. The winding engine consists of a 9ft diameter rope drum driven through a chain of gears by a 90 h.p. two-speed slip-ring induction motor running at 360 or 720 r.p.m. from a 400V, three-phase, 50 c/s mains supply. Normal braking is applied by a solenoid-operated brake on the motor shaft, but in the event of an electrical fault or an overwind, a weight-operated emergency brake may be applied to the winding drum by pressing one of the emergency stop buttons. When the emergency brake is applied the electric supply is automatically cut off and the winding engine cannot be restarted until the supply is reconnected.

On starting the cages from rest, the electric motor increases speed up to 720 r.p.m., equivalent to a cage speed of 4ft per second, through a series of starting relays ; and at a predetermined distance before decking level the motor speed is reduced to 360 r.p.m., equivalent to a cage speed of 2ft per second. On decking the motor cuts off and the brake is applied.

At bunker level there are four electrically-operated wagon tipplers, one opposite each end of the cages and in the positions shown in the plan at tippler level. In line with each tippler there is an air ram operating through a system of Westinghouse valves at a pressure of 80 lb per square inch. An empty wagon stands in one of the tipplers opposite each cage position, and when a cage bearing a full wagon decks at bunker level the air ram is operated, pushing the empty wagon from the tippler into the cage and the full wagon out of the cage into the opposite tippler, where it is emptied into the bunker below. Axle catches are fitted in the cages to hold the wagons in position whilst the cages are in motion, but the wagons are automatically released at bunker or pit bottom level by the wagons entering the cages.

Operation of the headgear is normally carried out by three men, one at bunker level, one at ground level, and one at the pit bottom. When winding tunnel spoil the cages and tippler equipment are worked by the bunker level operator, but when winding men or materials the ground level operator takes over control. In neither case, however, can the cages be moved until "cleared" by the pit bottom man, who is responsible for the loading and unloading at tunnel level. To change the control from one level to another both operators have to switch over, so that there is no possibility of one operator taking over the control of the cages without the other's knowledge. Materials which cannot be accommodated in the cages, such as long rails or pipes, can be slung underneath either of the cages and the ground level operator lowers the cage down the shaft by means of a "creep" button. On nearing the bottom of the shaft, the cage is stopped and the pit bottom man takes over control and "inches" the cage down slowly by means of a second "creep" button at the shaft bottom, whilst the material is being pulled into the tunnel and the sling chains unfastened.

Headgear at Brynbella Shaft

The headgears were designed and constructed in accordance with usual mining practice and the normal safeguards were incorporated in the design. Limit switches are provided to safeguard against over-winding on either cage, and detaching hooks provide an additional safeguard should the cages travel past the over-wind limit switches. In addition, slack rope devices are fitted so that should either cage for any reason become jammed in the guides, the slack rope device will cut off

the current and apply the emergency brake. An over-speed control is fitted to the winding engine and a number of interlocks are fitted at bunker level to ensure that the rams cannot operate unless the cages are at correct level, the tipplers cannot work unless the rams are withdrawn, and the cages cannot be moved whilst the ram gear is in operation. A signalling system is installed between the three operators and telephones are provided in addition to the signals.

The cost of keeping the headgears in operation has been very low and few parts have had to be replaced. Regular maintenance, such as oiling ropes and cage guides, general lubrication and cleaning electrical contacts is carried out weekly. Winding ropes are re-capped at approximately six-monthly intervals, the ends which are cut off being tested by the rope manufacturers.

At the peak period of work in the tunnels an average of 190 tons of spoil was wound up the 200ft deep shaft per 8-hour shift.

The Haweswater Aqueduct is being built to the requirements of the Manchester Corporation Waterworks, of which Mr. A. Atkinson, M.I.C.E., is engineer and manager. The civil engineering contractor for the Haslingden and Walmersley Tunnels is Edmund Nuttall, Sons and Co. (London), Ltd.; the headgears were built by Sheepbridge Engineering Ltd., and the automatic electrical gear by the Metropolitan-Vickers Electrical Company, Ltd.

8MeV Linear Accelerator for X-Ray Therapy

A travelling-wave 8MeV linear accelerator, which is the first of its kind to be built for X-ray therapy, has been installed for the Medical Research Council in a new building at Hammersmith Hospital, London. With its high-intensity radiation this equipment will, it is hoped, make possible the treatment of deep-seated tumours without prolonging the exposure time and damaging the skin. At normal power levels clinical dose rates up to 200r per minute at 1m from the target can be obtained.

IN last week's issue (page 513) we referred briefly to two new equipments installed in a special building at Hammersmith Hospital, London. The first is a travelling-wave linear accelerator developed and designed, for X-ray therapy, by the Atomic Energy Research Establishment, Harwell, and the Radiotherapeutic Research Unit of the Medical Research Council, in collaboration with Metropolitan-Vickers Electrical Company, Ltd., who built the equipment. It was installed at the south end of the new building, in February last, and has been in regular operation since August.

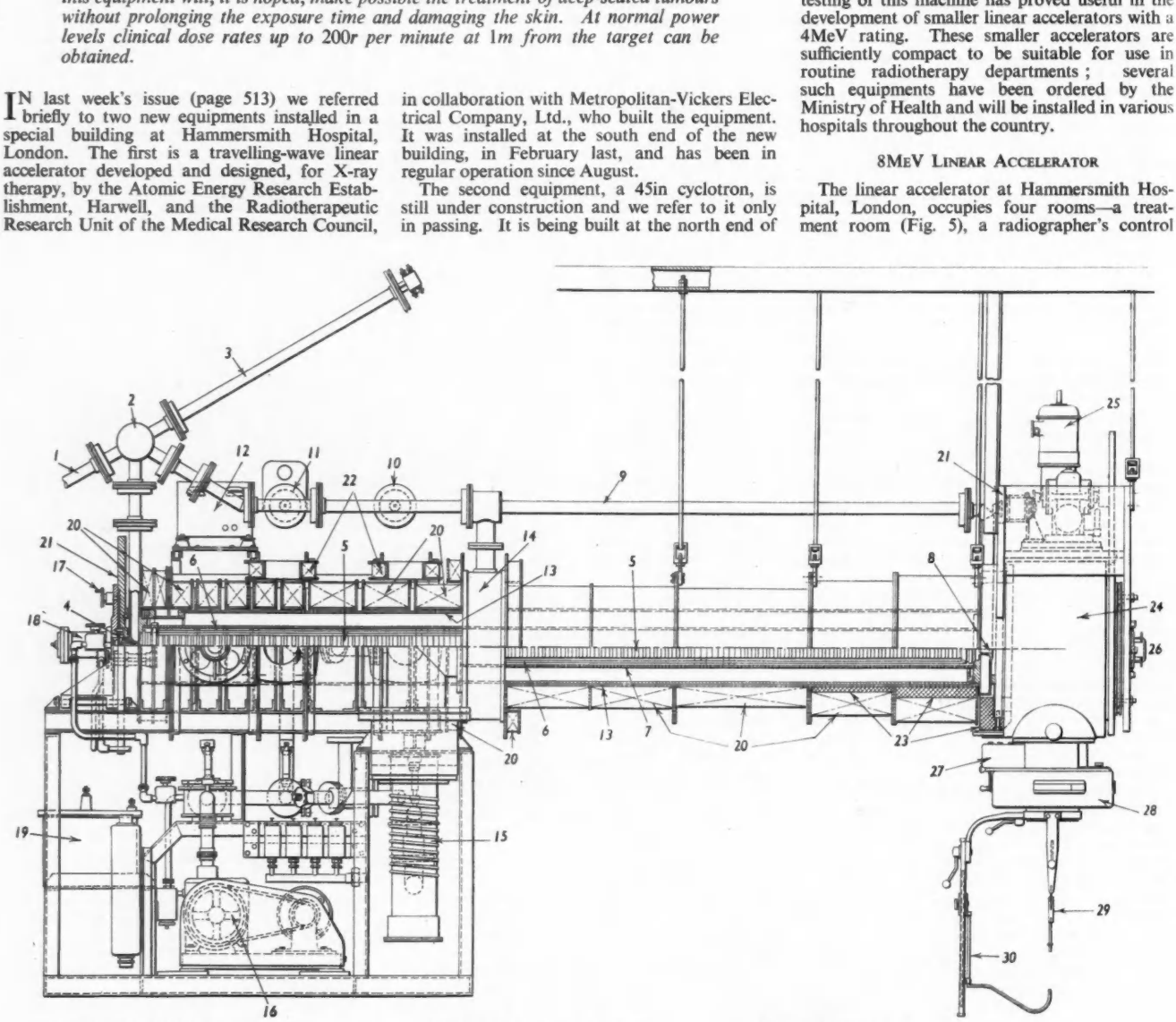
The second equipment, a 45in cyclotron, is still under construction and we refer to it only in passing. It is being built at the north end of the new building, where it will be enclosed in a room with concrete walls and ceiling from 6ft to 10ft thick, the two means of access being sealed by sliding concrete doors weighing 35 tons and 190 tons respectively. Remote control will be effected from a separate room. The cyclotron will be used to produce an intense beam of high-speed neutrons to examine the effect of this form of radiation on living and inert tissues and, in particular, to determine its effectiveness in the treatment of malignant disease. Another function of the cyclotron will be the production of certain isotopes which cannot usefully be produced in atomic piles. It may, for example, be used to produce isotopes which have a very short life and must therefore be used as soon as they are produced.

The linear accelerator, for its part, has been in use long enough for some of its advantages to become apparent, although, as the Medical Research Council points out, a full assessment of this form of therapy is part of a long-term programme. Two immediate merits of the accelerator are, first, that exposure intervals are relatively short and that more patients can be treated in a given time; and, secondly, that high dosage can be applied to deep-seated tumours without damage to the skin.

Already the experience gained during the testing of this machine has proved useful in the development of smaller linear accelerators with a 4MeV rating. These smaller accelerators are sufficiently compact to be suitable for use in routine radiotherapy departments; several such equipments have been ordered by the Ministry of Health and will be installed in various hospitals throughout the country.

8MeV Linear Accelerator

The linear accelerator at Hammersmith Hospital, London, occupies four rooms—a treatment room (Fig. 5), a radiographer's control



1—Wave-guide feed from magnetron
2—Wave-guide bridge (rat-race)
3—Resistive water load
4—Input feed (door knob)
5—Accelerator tube (corrugated wave-guide)
6—Water cooling tubes
7—Support tube for corrugated wave-guide
8—Output feed
9—Wave-guide feed-back
10—Phase adjuster (manually operated)
11—Phase adjuster (servo operated)
12—Servo amplifier
13—Vacuum envelope (main tube)
14—Vacuum manifold
15—Two 063B oil diffusion pumps
16—Two SR3 rotary pumps
17—Gun vacuum air-lock control
18—Diode electron gun
19—Bifilar choke for gun filament supply
20—Focusing coils
21—Magnetic screen
22—Centralising coils
23—Lead protection
24—Rotating X-ray head
25—Head driving motor
26—Removable heavy-alloy plugs for electron beam extraction
27—Lamp housing, for optical field illuminator
28—Adjustable heavy-alloy diaphragms
29—Retractable front pointer
30—Removable back pointer

Fig. 1—Cross Section of 8MeV Linear Accelerator

room, a technical control room and a pump room. The main tube of the accelerator, with the X-ray head mounted at one end, projects about 6ft into the treatment room and is supported from the ceiling as shown in Fig. 1. This arrangement gives the maximum amount of freedom in the positioning of the patient, which is done by co-ordinated movement of the floor, the couch and the X-ray head through a simple control column which can be seen in Fig. 5. The couch is mounted so that it can move horizontally on sunken rails in the treatment floor and the floor itself can be raised or lowered. By means of Magslip resolvers and servo mechanisms, the vertical movement of the floor and the horizontal movement of the couch are electrically coupled to the rotation of the X-ray head, about the axis of the accelerator tube (Fig. 1). These movements are so co-ordinated that the point of incidence of the beam on the patient's skin is fixed. In practice the region to be treated, the required point of incidence and the corresponding point of exit will have been determined beforehand. It is then a comparatively simple matter to position the patient on the couch and carry out the required adjustment with the help of the single lever control, making use of the entry and exit pointers, marked (29) and (30) on Fig. 1.

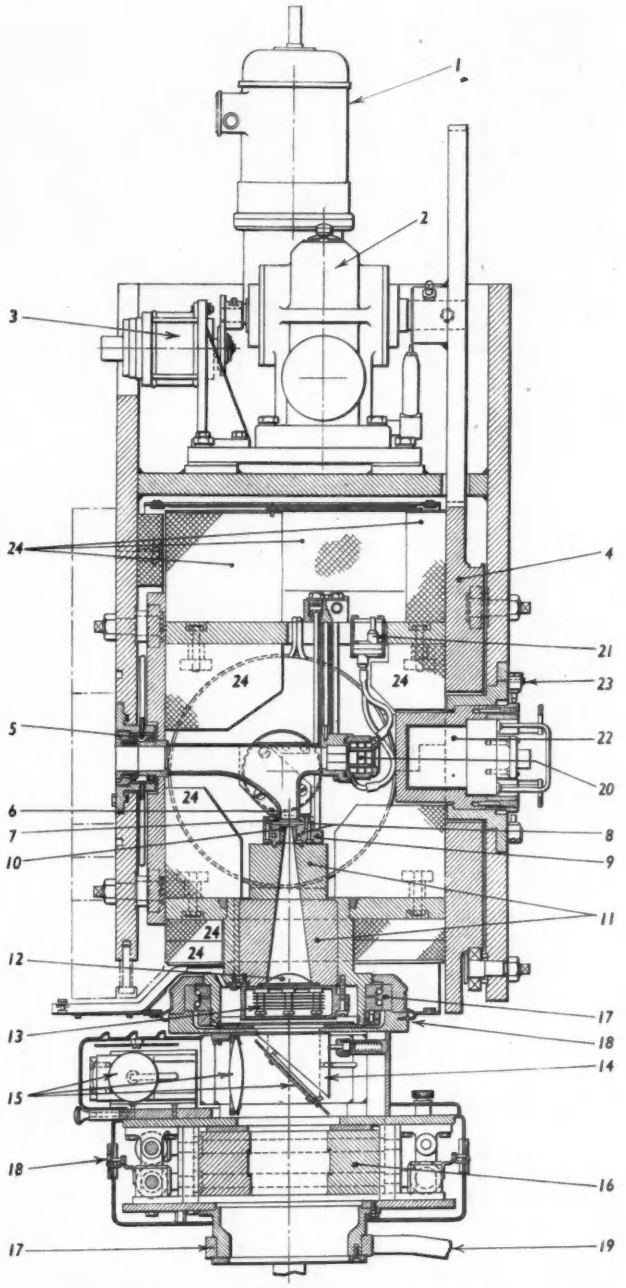
In this equipment electrons are accelerated by the action of 10cm radio-frequency waves down a circular copper "corrugated" waveguide, which is 3m long. This wave-guide is "corrugated" by virtue of the fact that it is built up of a series of iris diaphragms (Fig. 4). The effect of these diaphragms is to make the r.f. waves travel along the corrugated waveguide at a velocity determined by the diameters of the tube and the iris diaphragms.

The radio-frequency waves for accelerating the electrons are produced in a magnetron from which pulse output powers of the order of 2000kW at a free space wavelength of about 10cm can be obtained. Waves from the magnetron are fed to the corrugated wave-guide ((5), Fig. 1) through a standard rectangular waveguide (1). Simultaneously, electrons from the 45kV diode electron gun (18) are injected into the corrugated wave-guide in the same direction as that of the radio waves and at the same speed. Under the influence of the electric field associated with the travelling wave the electrons are gathered into bundles and accelerated along the corrugated wave-guide.

A simplified concept of the action of the machine can be derived from Fig. 2 and the analogy of a surf rider propelled by a sea wave. The two diagrams in Fig. 2 show an instantaneous plot of the electric field of the wave along the accelerator and the electron distribution relative to the wave. Referring to the upper diagram, the electrons soon after injection are travelling faster than the wave at (*A*) and slower than the wave at (*B*). At (*C*) the electrons are oscillating about equilibrium position at zero field and at (*D*) they form a stable bunch with a velocity equal to the wave velocity and without achieving any gain in energy. The lower diagram depicts the conditions that obtain when the wave velocity instead of being constant is increased along the wave-guide tube, as is done in practice. As before, the electrons pass through the intermediate stages (*E*) slower than the wave and (*F*) faster than the wave before reaching a position (*G*) in which they oscillate about an equilibrium position at some finite value of the accelerating field. At (*H*) the electrons are forming a stable group with the same increasing velocity as the wave and are gaining corresponding amounts of energy from the wave. At (*J*) the velocity of the group is beginning to approach c, the velocity of light and the mass of the electrons is increasing. At (*K*) the velocity is almost constant, but the electrons are still gaining energy from the wave in the form of increasing mass.

This "relativistic" gain in the mass of the electrons, as indicated in the lower diagram, is essential to the operation of the accelerator. The electrons are injected at a velocity of about $0{\cdot}4c$. When they reach the target end of the corrugated wave-guide the electrons have a velocity of about $0{\cdot}996c$ and their "relativistic" mass has increased about twentyfold. The corrugation pitch is 1cm over the first 40cm length of the wave-guide and 2cm over the remaining 260cm length. Details of the calculation of the wave-guide dimensions are given elsewhere.[1,2]

Another important principle in the operation of the accelerator is the use of r.f. feed-back[3] from the target end of the tube. There is a rectangular wave-guide (9), Fig. 1, connecting the output end of the corrugated wave-guide to a bridge or "rat-race" (2) at the input end. With the help of two-phase adjusters (10) and (11) in this feed-back guide, the attenuated waves are returned to the "rat-race" (2) in the required phase relationship to augment the power from the magnetron and raise the efficiency of operation. Feed-back provides a power flux of about 3·6MW from the magnetron which generates r.f. pulses of 2 microseconds duration and 2MW peak power.[1]



1—Driving motor for head rotation
2—Reduction gearbox
3—Magslip resolver
4—Rotating iron frame of magnet
5—Rotating vacuum seal (120 deg.)
6—Magnet pole
7—Gold target
8—Heavy-alloy flanges
9—Water cooling
10—Uranium diaphragm
11—Heavy-alloy diaphragms
12—Beam flattening filter
13—Ionisation chambers
14—Removable wedge filter
15—Optical field illuminator
16—Adjustable heavy-alloy diaphragms
17—Bearings for 360 deg. rotation
18—Scales
19—Support for beam-defining pointers
20—Calorimeter
21—Thermocouple
22—Removable heavy-alloy plugs
23—Plug interlock
24—Lead protection blocks

Fig. 3—Cross Section of X-Ray Head for Linear Accelerator

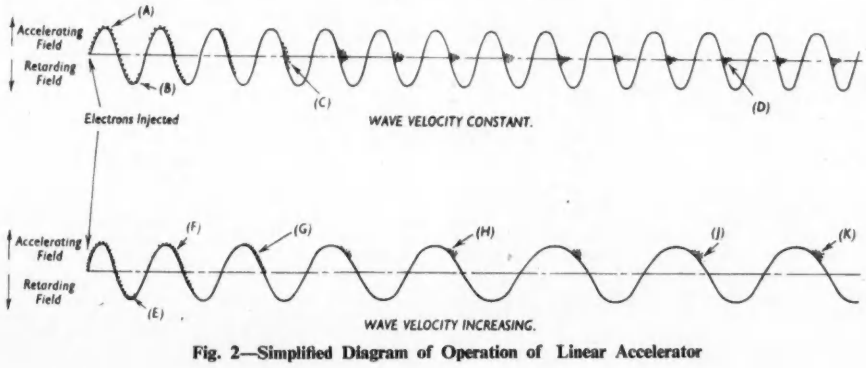


Fig. 2—Simplified Diagram of Operation of Linear Accelerator

The construction of the X-ray head is shown in Fig. 3. The electron beam emerging from the corrugated wave-guide is bent through 90 deg. by an electromagnet (6), Fig. 3, and then strikes a water-cooled gold target (7). Bombardment of this target by electrons produces an X-ray beam which is collimated by fixed heavy alloy diaphragms (10) and (11) to give a maximum useful field of 25cm diameter, or a rectangle of 20cm by 15cm, at 1m from the target. The rectangular field size is adjusted with the help of a system of sliding heavy alloy blocks (16). Inserts in the sliding block system provide the circular fields. Illumination of the area being treated is given by a lamp and optical system (15).

Indications of the dose rate and the total dose at 1m from the target are given by two

ionisation chambers (13) which are mounted at a distance of 25cm from the target. These indications also provide a signal to operate an automatic dose rate stabiliser. There is also provision for a beam-flattening filter (12) and for the introduction of a wedge filter to produce a graduated beam intensity when required.

By switching off the deflector magnet in the X-ray head the electron beam, instead of striking the gold target, can be absorbed in a water calorimeter (20) whereby the beam energy can be measured; alternatively, subject to the necessary safety precautions, the beam can be allowed to emerge through a thin window.

As previously stated, the X-ray head can be rotated in a vertical plane by a motor drive (1) and gearbox (2), about the horizontal axis of the accelerator tube. The limits of this rotation are 15 deg. above the horizontal and 15 deg. beyond the vertical downwards, giving a total rotation of 120 deg. Through the Magslip resolver (3) the rotation of the X-ray head controls the vertical movement of the floor and the horizontal movement of the couch in such a way that the point of entry of the beam into the patient remains fixed.

The vacuum system of the linear accelerator is maintained by two "Metrovac" 063B 6in oil diffusion pumps (15), Fig. 1, backed by two "Metrovac" SR3 rotary pumps (16). This system evacuates an envelope (13) enclosing the corrugated wave-guide, which is drilled with circular pumping holes as shown in Fig. 4. The pumping system is automatically controlled and is interlocked with the operational controls of the complete equipment. The electron gun has a vacuum air-lock so that filaments can be replaced without losing the vacuum on the rest of the equipment. Magnetic focusing of the electron beam is achieved by coils (20), Fig. 1, surrounding the accelerator tube along the whole of its length.

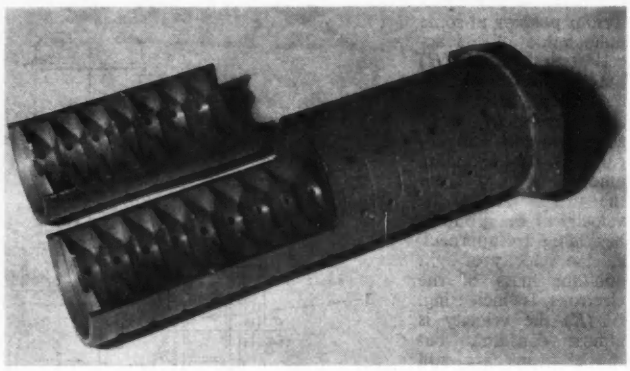


Fig. 4—Portion of Corrugated Wave-guide

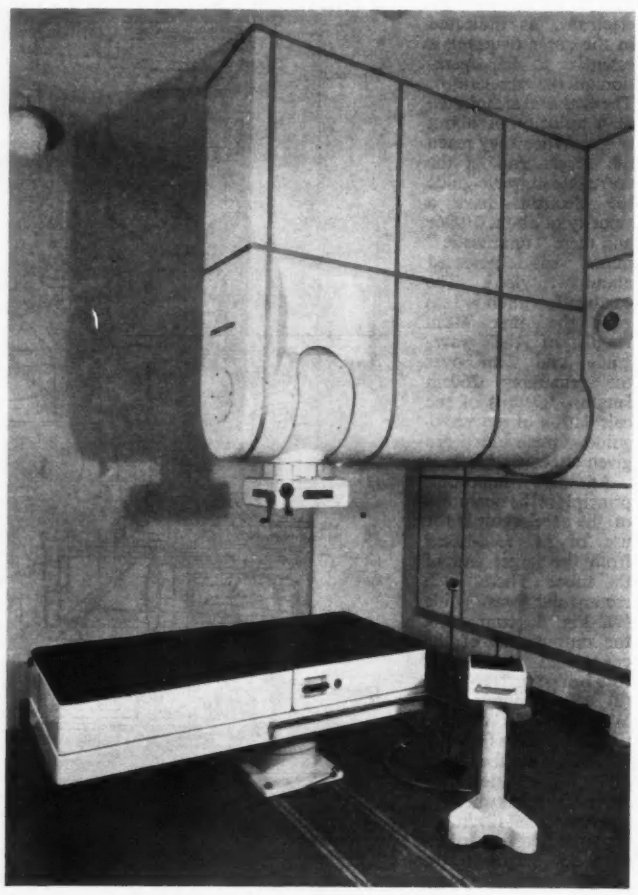


Fig. 5—Treatment Room With Linear Accelerator

As previously stated, approximately 6ft of the accelerator projects into the treatment room. The remainder of the accelerator (the left-hand portion of Fig. 1) is in the adjoining pump room. Beyond that is the technical control room housing the magnetron and associated apparatus and control panels, whereby measurements and adjustments (apart from those under the control of the clinical operator) can be made. The equipment in this room includes instrument panels for synchronising, vacuum measurement, and beam intensity measurement by water calorimeter. On the r.f. side of the accelerator there are two magnetrons, one of which acts as stand-by.

In the main clinical control room there is a desk incorporating all the operating controls. A periscopic arrangement, consisting of a system of mirrors and a hole passing obliquely through the concrete protective wall, enables the operator at the control desk to see the patient in the treatment room. From this desk the accelerator can be energised by push-button control and the required X-ray dose can be administered, either by applying a selected dose rate under the control of a timer or by an integrating controller which switches off the dosage after a given total radiation. The control desk carries instruments and indicating lamps whereby the operator can check whether the equipment is functioning correctly and the main operating controls are interlocked with the communicating doors.

Details of the performance of the linear accelerator have been published elsewhere.[1] For clinical use the equipment is intended to be operated at dose rates up to 200r. per minute at 1m from the target and a normal single treatment will require an exposure of about two minutes. This output is well below the maximum obtainable and it allows for stabilisation with respect to power and frequency and for losses in the X-ray head, including the beam flattening filter. Conversion of electron energy to X-ray output is effected at 18·2r. per minute per μA at 1m for an electron energy of 8MeV.

Greater outputs can be obtained by running at a higher power level and increasing the recurrence rate above the nominal maximum value of 500 pulses per second. For example, at 600 pulses per second the X-ray output can be increased to 1000r. per minute at 1m; at 700 pulses per second an output of 1250r. per minute at 1m has been attained.

Long-term stability of the equipment is ensured by the servo operated phase shifter,[4] (11), Fig. 1, in the wave-guide feed-back circuit. This phase shifter applies an automatic correction for frequency drift and temperature changes in the corrugated wave-guide.

REFERENCES

[1] "Travelling Wave Linear Accelerator for X-Ray Therapy," C. W. Miller, *Nature*, 171, February 14, 1953.
[2] W. Walkinshaw, *Proc. Phys. Soc.*, 61, 246 (1948).
[3] R. B. R. Shersby-Harvie and L. B. Mullett, *Proc. Phys. Soc.*, 62, 270 (1949).
[4] L. B. Mullett and C. W. Miller, Brit. Pat. Spec. No. 673,957

Oil Pollution Research

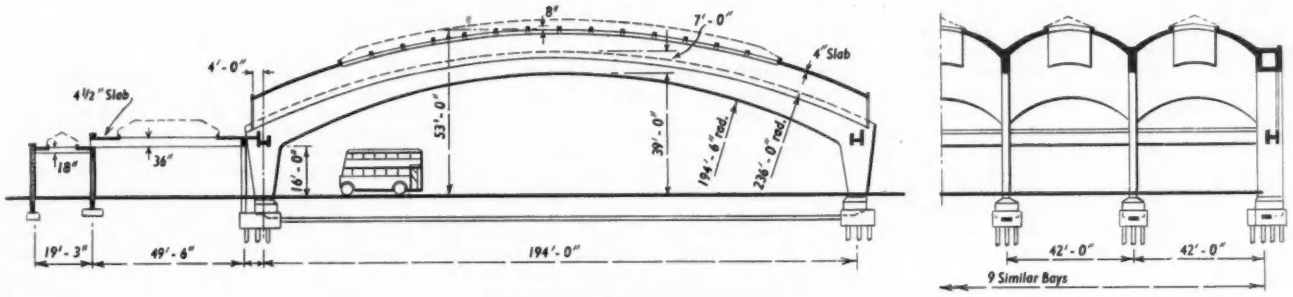
THE Admiralty has announced that as a contribution to the campaign against the pollution of this country's beaches by oil residue jettisoned from ships, the National Institute of Oceanography will shortly initiate an intensive research into the surface currents in the North Atlantic to the west of the British Isles. It is planned to drop into the sea 10,000 plastic envelopes, many of which will eventually float ashore on the coasts of Britain and other N.W. European countries. Each envelope will contain a franked, addressed postcard, on which will be printed a simple questionnaire, and a small sheet of instructions for completing it. To make the envelopes catch the eye more readily, the postcard will bear a wide red stripe and the instructions will be on yellow paper. Finders will be asked to write on the postcard their name and address, and the date and place of recovery of the envelope. The instructions will be printed in eight different languages. A reward of a half-crown, or its equivalent in foreign currency, will be paid to the sender of each postcard which is received by the National Institute of Oceanography at its headquarters at Wormley, near Godalming, Surrey. The cards will be numbered, and the date and position in which each is dropped will be recorded. It will thus be possible to work out the approximate speeds and directions of the currents from the information received on the postcards. If a large percentage of the envelopes dropped in any area is recovered, it follows that oil jettisoned in that area is very likely to drift ashore. On the other hand, if no envelopes from that area are recovered, there are strong grounds for assuming that oil jettisoned there is unlikely to come ashore. Dropping of these envelopes is to be carried out from Coastal Command aircraft on navigational training flights. The dropping track will run from the Bay of Biscay, roughly in a semi-circle of 500 miles radius, to a point halfway between the Hebrides and Iceland, and will thus stretch from side to side of the north-east-going belt of current which crosses the Atlantic in these latitudes. In order to learn more about seasonal changes in the currents, about 2000 envelopes will be dropped in the early spring, autumn and winter of 1954; double that quantity will be released in early summer, when the chances of recovery by holiday-makers between one and three months later will be greater than during the other seasons.

PIT-PROP FOOT PLATE.—The National Coal Board says that a pit-prop foot plate designed to minimise floor penetration has been developed at Gedling Colliery, near Nottingham. The foot plate is in the form of an inverted bowl, the centre of which is thickened to a point projecting downward. The top of the device is dinted to provide a spherical bearing surface for the prop foot. The principle of the foot plate is that as the resistance offered by the prop to roof movement begins to exceed the resistance of the floor to penetration by the plate, the floor will be forced up inside the plate. The interior shape of the latter will cause the soft material of the floor to be compressed to a hard mass, and a "pressure cone" will be formed. This will tend to minimise the flow of the floor material outward past the edges of the plate and a high resistance to penetration will be developed.

Stockwell Bus Garage

The London Transport Executive has recently constructed a bus garage at Stockwell with an unobstructed floor area of 73,350 square feet. The structural frame of the building consists of reinforced concrete arched ribs spanning 194ft and spaced 42ft apart with arched vaults between them. The various services and equipment installed in the garage are briefly described, but the principal part of this article concerns the structure itself.

THE new bus garage which the London Transport Executive has erected at Stockwell is an impressive and original example of structural design in reinforced concrete. The general conception of the building will be apparent from the illustrations accompanying this article, but we will first outline the various basic requirements which led to this conception before describing the structure itself. The principal requirement was for a covered parking space, adequate for 200 buses, together with comprehensive facilities for inspection, fuelling, maintenance and repair, and with ancillary accommodation such as offices and canteens.



Cross and Longitudinal Sections

It is well-known that the need for a large floor space, unobstructed by intermediate columns, is of considerable importance in a large bus garage; thus many of these buildings are of considerable interest to the structural engineer, because of the large spans which must be provided. The need for the maximum unrestricted floor space was therefore the over-riding influence in the design of the Stockwell garage. The main building is 392ft long and 194ft wide, and is spanned across the shorter of these distances by reinforced concrete arched ribs, spaced 42ft apart, whose form is shown in the accompanying elevation. The height of the soffit of the springing of the arched rib was the prescribed head-room of 16ft and the arched rib with its two columns forms a two-hinged rigid frame, carried on a piled footing at the base of each column, and tied between the column bases below floor level. The rise of the arch was fixed from a number of considerations, both structural and architectural. Another factor which influenced the design was the need for large glazed areas, both in the roof and in the perimeter walls. The two photographs of the completed building reproduced with this article give a good idea of the glazed areas; the glazing in the background of the first of them in the spandril of the end arched rib, may be noted, as well as the extensive glazing in the side wall shown in the second. There is as well, a strip 14ft wide, running for most of the length between each pair of arched ribs. The arches which span the 42ft between the main arched ribs are not "shell" roofs, as that term is generally understood. They act as cantilevers on each side of the main ribs, as far as the dead load is concerned. To take live loads, however, they act as encastré arches in conjunction with the 6in wide ribs which pass across the glazing at 10ft centres.

All the internal main arched frames of the building are 26in wide and 7ft deep at the crown, increasing to 10ft 6in at the haunch and decreasing again to 6ft at ground floor level. The two end frames consist essentially of a member of the same dimensions as the internal ribs plus an external member 18in wide connected to the 26in rib by 12in slabs at top and bottom, to form a reinforced concrete box 8ft wide. This section is designed to withstand any out-of-balance thrust arising from live loading conditions. Below floor level, the rib sections are widened out to provide increased stability, as the only longitudinal tie between the frames is the "H" beam at haunch level, which is shown in the illustration. This beam is carried round the four sides of the garage and also conceals the 9in cast iron rain disposal pipe, the 6in sprinkler main, compressed air and water ring mains and electric lighting and clock conduits. From it, also, are hung the main entrance doors and those to the docking area. Expansion joints are provided in the "H" beam on each side of the garage.

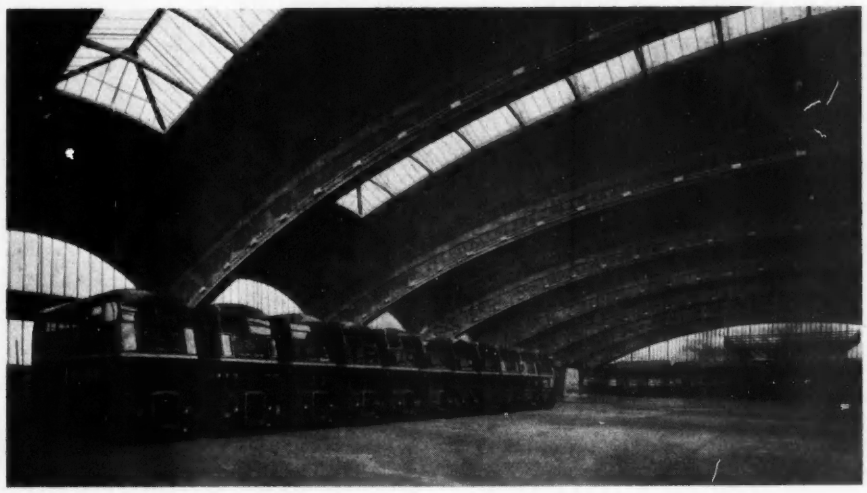
Where the main frames rest on the pile caps, hinges are provided, and the thrust arising from the arch action is taken by steel ties consisting of 1¼in diameter bars coated in bitumen and encased in concrete, connecting opposite pile caps. Details of this arrangement are shown in one of the accompanying drawings. A typical column carries a vertical load of 375 tons and takes a side thrust of 260 tons, of which about 15 per cent constitutes live load. There are eight or nine cast *in situ* piles carrying each internal column, the nominal working load of the piles being 60 tons each; they were driven into the London clay.

The comparatively small section of the main frames made it essential to weld the main reinforcement instead of providing the customary laps and some 1200 "V" butt welds were made in the arch ribs and ties connecting the pile caps. The single "V" weld was adopted owing to the necessity for welding in position the several layers of main bars at the most critical section nearest the haunches. To minimise the weakness of a possible faulty weld, welding points for each layer were staggered and the positions arranged as far as practicable away from sections of maximum bending moment. The concrete mix for the main frames and connecting vaults was specified at 1 : 1½ : 3 nominal and elsewhere 1 : 2 : 4 nominal and design stresses throughout were in accordance with L.C.C. by-laws. The richer mix gave 28-day cube strengths of about 4500 lb per square inch.

The whole of the erection was carried out according to a strict schedule, in which the position of construction joints was clearly defined. The main frames were cast in four stages, the first being the column, up to the springing level; the second, the springing of the arch and about 25ft of the arch, measured from the column, the third, nearly 50ft of the arch, next to the previous section, and finally, the closing central section, just over 30ft in length. The illustration on page 559 gives an idea of the complexity of the reinforcement in each of the main frames.

Part of the secondary arches were cast with the main ribs, as the cross sectional details show. The remaining length of the cantilever section, out as far as the edge of the glazed area, was then cast on. The centering for this part was removed before the thrust beams spanning the glazing (or alternatively the closure slabs) were placed in position, thus ensuring that the dead load was taken by the cantilever action, as explained earlier, and the thrust beams formed an encastré arch to take the live loads and avoid any torsion stresses in the main beams due to asymmetrical live loading. The secondary vaults have a radius of 27ft, with glazed areas 140ft by 14ft in each 4½ft bay.

The shuttering and centering arrived at the



Arch-Rib and Roof Structure of Garage

site in prefabricated elements, all marked for their positions, in accordance with the erection schedule. The centering for the main arches, which is shown in the illustration below, was erected from tubular steel scaffolding. There were seven sections to this centering, mounted on wheels, which were jacked up into position for concreting, and lowered on to the wheels for removal to the next rib position. Propping sections were left in position at the third points of the newly cast rib until it had matured. The secondary arch shuttering which was curved in two directions was prefabricated in timber, but otherwise steel forms were used extensively. The biggest concrete pour was about 40 cubic yards (the second stage in the construction of a main rib), which was generally poured at about 8 cubic yards per hour. The concrete was placed by pump and consolidated with immersion vibrators. The concrete surfaces have been left direct from the shuttering, after rubbing down.

Services and Equipment

The heating of the building, which is thermostatically controlled to suit the outside temperature, is by low-pressure hot water circulated by pumps from the boiler house, in which the boilers are automatically stoked. The heating mains leave the boiler house by way of a crawl duct to the workshops and office block. In the docking area there are radiant panels in the ceiling along the soffit between the beam sides and deck lights, and the pits are individually warmed by heating coils.

Ventilation of the docking area, which is situated next to the main parking area, is by clerestory windows over the workshops, fumes from bus engines being extracted from the pits through underground pipes and exhausted to the open air by fans. A separate exhaust system is fitted to remove fumes from the battery-charging area.

Three washing machines for washing the backs and sides of buses, together with a roof washing machine, are to be provided in due course beyond the fuelling islands. The steel gantry, to support these machines, and the vacuum stand pipes are suspended from the arches by steel tubes and can be seen in one of the illustrations.

Vacuum cleaning facilities are provided by a 40 h.p. installation in the main servicing area, which allows eight operators to work simultaneously and so enables both decks of a bus to be cleaned at the same time on each of the four servicing approaches. A 10 h.p. plant is provided in the docking area, for periodic upholstery cleaning, and has connection points in each of the seventeen pits.

Stockwell Bus Garage

A compressed air ring main feeds the docking area and associated workshops with compressed air at approximately 90 lb per square inch, while high pressure air, at 200 lb per square inch, is provided for tyre inflation. The installation is fed from a set of three compressors, each of 24 c.f.m. capacity at 200 lb per square inch, the lower pressure being provided to the ring main by single reducing valves.

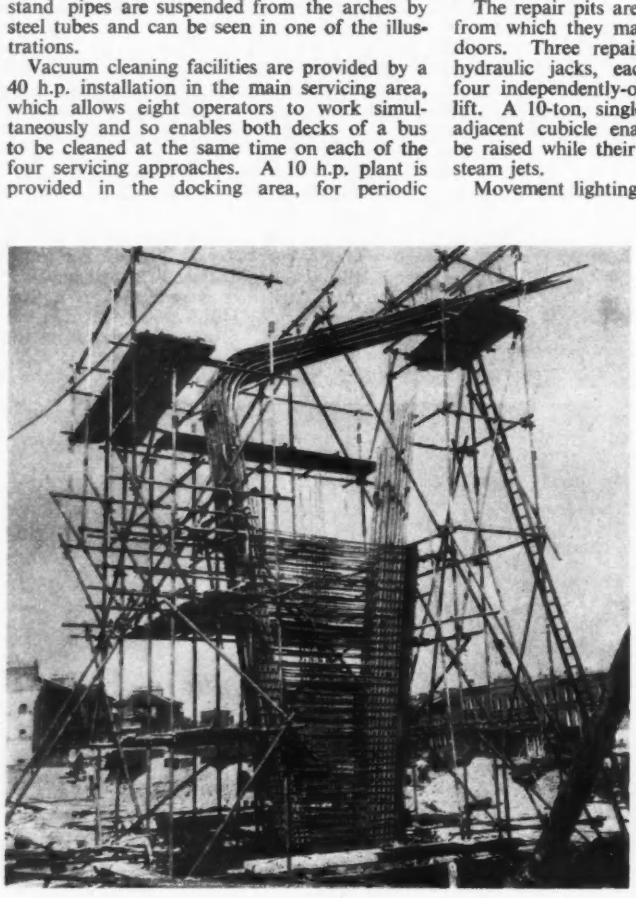
Used oil from the docking area is gravity fed to an adjacent underground tank, whence it is transferred by a float-controlled electrically-operated pumping system to storage tanks, pending disposal.

The repair pits are clear of the parking area, from which they may be separated by folding doors. Three repair pits incorporate built-in hydraulic jacks, each installation comprising four independently-operated jacks with a 12in lift. A 10-ton, single post, hydraulic lift in an adjacent cubicle enables complete vehicles to be raised while their undersides are cleaned by steam jets.

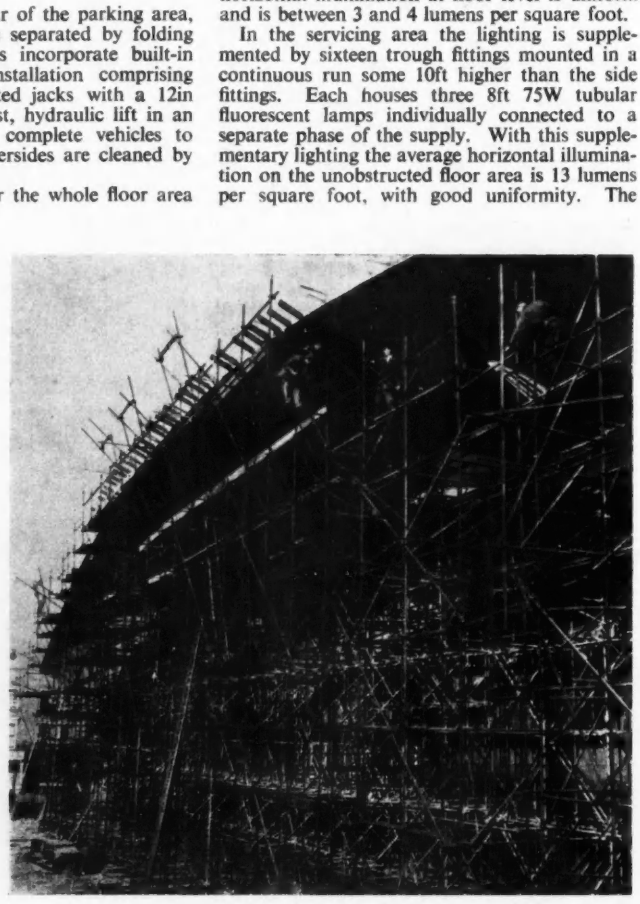
Movement lighting over the whole floor area of the main building is provided by continuous runs of bare 8ft 75W tubular fluorescent lamps following the arch of the main ribs, a run consisting of twenty-two lamps supported by simple shallow-box units mounted directly on to the ribs. Each box houses the transformer for operating one lamp and the capacitor for power factor correction. A channel between each box carries supply cables and earthing wire. Spring-loaded lamp-holders permit the lamps to be changed by one man.

Each pair of rows is approximately 40ft from the next, the mounting height being determined by the arch of the rib and varying between 18ft and 40ft above floor level. The average horizontal illumination at floor level is uniform and is between 3 and 4 lumens per square foot.

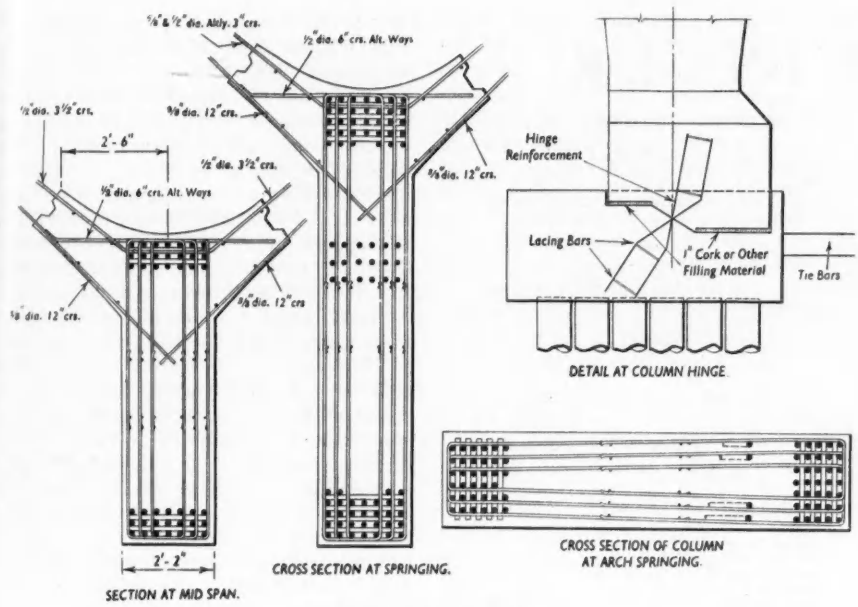
In the servicing area the lighting is supplemented by sixteen trough fittings mounted in a continuous run some 10ft higher than the side fittings. Each houses three 8ft 75W tubular fluorescent lamps individually connected to a separate phase of the supply. With this supplementary lighting the average horizontal illumination on the unobstructed floor area is 13 lumens per square foot, with good uniformity. The



Reinforcement in Typical Column



Arch-Rib Centering


⅛" & ½" dia. Alty. 3" crs.
½" dia. 6" crs. Alt. Ways
½" dia. 3½" crs.
⅝" dia. 12" crs.
2'-6"
½" dia. 3½" crs.
½" dia. 6" crs. Alt. Ways
⅝" dia. 12" crs.
⅛" dia. 12" crs.
⅝" dia. 12" crs.
2'-2"
SECTION AT MID SPAN.
CROSS SECTION AT SPRINGING.
Hinge Reinforcement
Lacing Bars
1" Cork or Other Filling Material
Tie Bars
DETAIL AT COLUMN HINGE.
CROSS SECTION OF COLUMN AT ARCH SPRINGING.

Details of Main Arched Frame

vertical illumination on a bus parked in a row 6ft away from other rows varies between 1¼ lumens per square foot at ground level to 2 lumens per square foot at 6ft above ground. A metal-enclosed unit distribution switchboard receives the main incoming supply at 440V, three-phase, four-wire, 50 c/s, and controls all the lighting and power circuits in the garage. This main supply is controlled by a 500A fused switch. Several switches, varying in size from 60A to 200A, are mounted above and below the main busbars and control the lighting and power distribution fuse boards and final sub-circuit boards.

The Stockwell garage was constructed as part of the London Transport Executive's scheme to replace London's remaining trams by buses. It has been partly in use since April, 1952, and is now approaching completion, and is about to be brought into full use.

The consulting engineer responsible to the L.T.E. for the structure of the garage is Mr. A. E. Beer. The main contractor is Wilson Lovatt and Sons, Ltd. The heating and ventilating systems were designed under the supervision of Mr. H. Carter, the new works' engineer of the L.T.E. The lighting was designed by J. H. Coombs and Partners, with the various fittings supplied by the Metropolitan-Vickers Electrical Company.

Refuse Disposal Plant at Sheffield

A NEW refuse disposal plant has been installed at the Penistone works of the Sheffield City Council by Heenan and Froude, Ltd., of Worcester. This plant, which cost just over £250,000, is designed to deal with some 260 tons of crude refuse per eight-hour working day and has an incinerator to deal with 90 tons of tailings in the same period.

In the new plant incoming vehicles are first weighed and then driven up an inclined roadway into the tipping house, where their loads are deposited into one of two reception hoppers, each of which has a capacity of 120 cubic yards. At the bottom of each hopper is a 9ft wide plate feed conveyor which can be operated at two speeds to control the rate of flow according to the type of refuse being handled.

Two pairs of wide-troughed elevating belt conveyors take the refuse from the feeders to horizontal revolving barrel primary screens having internal spirals to propel the refuse over the mesh plates. The first section of mesh provides preliminary separation of dust, which is discharged to a belt conveyor, whilst the second section of mesh extracts the over-size materials for treatment in the secondary screens. The rejects, or "tailings," are fed from the primary screens to the picking belt conveyors. In two secondary screens similar in construction and operation to the primary screens, the remaining dust is extracted in the initial section, whilst on the adjacent mesh crude cinders are taken out. The dust passes to the belt conveyor and the cinders on to garbage separators.

The garbage separators are arranged in two pairs below the screens, and they serve to remove a large proportion of the dross, vegetable and other useless matter, so that a comparatively clean product remains. The cleaned cinders are collected on to a belt conveyor and the tailings from the secondary screens and debris from the garbage separators are discharged to the picking belt conveyors for eventual transfer to the incinerator. The dust and cinder conveyors elevate the materials to reinforced concrete hoppers, the dust section of which has a capacity of 60 tons and the cinders portion of 30 tons. Quick-acting roller doors fitted in the base of the hoppers permit rapid gravity loading to vehicles standing beneath. This entire screening process can be by-passed by utilising special chutes which divert the crude refuse from the head of the second pair of elevating conveyors direct to the picking conveyors.

All the tailings are taken by two wide slowly moving picking belt conveyors into the salvage room, where men stationed alongside throw the recovered articles into conveniently arranged chutes leading to storage bins sited on the floor below. Above each picking conveyor an electro-magnetic overband separator is fitted for extracting tins and ferrous metals, the recovered material being conveyed by chute to an enclosure on the floor below. Two mechanically operated scrap metal balers deal with the recovered tins.

Materials remaining on the picking conveyors after salvaging operations have been completed are delivered to a pair of troughed elevating belt conveyors leading to a central point in the incinerator house. At this position the tailings are discharged by means of cross-over chutes to either of two distributing belts, which extend above the two incinerator units. Each distributing conveyor is fitted with a travelling tripper arranged so that the tailings may be discharged direct to the top feed openings in the incinerators or on to a storage floor for hand-feeding to the furnaces during extended hours of working.

The incinerator is of steel cased mechanical design with hydraulically operated grates, and it consists of two units each of five cells with combustion chambers and a special arrangement for burning condemned carcases. Each of the ten grates is supported on a carriage which is withdrawn by hydraulic power when clinkering becomes necessary; the clinker is scraped off by the ploughing action of the deadplate under which the moving grate passes. The clinker gravitates down a cast iron chute to an enclosed chamber at ground level. A stillage system of clinker skips is so arranged that the falling clinker is caught and stored in a convenient position for quenching by high pressure water jets, and subsequent disposal to the clinker yard or to a clinker handling plant.

For dealing with bulky combustible material such as old furniture and bedding, &c., a bridge is provided to connect the tipping floor to the incinerator top charging platform, where one of the furnaces is equipped with a large mechanically operated charging door. The bulky articles are wheeled across the bridge and fed directly into the furnace.

The hydraulic system of the plant is supplied with pressure fluid by duplicate high-pressure pumps and an accumulator, coupled to special control valves, cylinders and piping. The operation of the control valves is from the front of the furnaces and is interlocked with the control of the quenching water and the quenching chamber doors.

The gases leaving the incinerator pass through a flue system to a dust catcher and thence by a short flue to a brick chimney. In order to improve working conditions, dust-collecting plant has been fitted in the handling, screening and salvage sections; twin units are arranged to deal with dust arising from the refuse reception hoppers, whilst dust disseminated in the screen house and picking-room is collected at various focal points by two other units.

For housing the plant an old destructor house, being particularly commodious, was adapted to provide a tipping house with a large area for manœuvring vehicles under cover. The new buildings erected for the plant comprising the screen house, picking and salvage rooms, and incinerator house, are of modern construction, and have concrete framing, with brick walls, continuous side glazing and reinforced concrete barrel vault roofs.

British Standards Institution

All British Standard Specifications can be obtained from the Sales Department of the Institution at 2, Park Street, London, W.1

ALUMINIUM NICKEL IRON BRONZE RODS AND FORGINGS FOR GENERAL ENGINEERING PURPOSES

No. 2032 : 1953. Price 2s. 6d., and No. 2033 : 1953. Price 2s. 6d. These two standards have been prepared to reduce the number of alloys in the field they cover, the two compositions chosen being those which have characteristics and mechanical properties which cover as far as possible all known applications.

In B.S. 2032 the composition is a compromise between those of two Ministry of Supply material specifications, D.T.D.160, "Aluminium Bronze for Valve Seats," and D.T.D.174, "Aluminium Bronze Sand or Die Castings." In B.S. 2033 the composition approximates to that of D.T.D.197, "Aluminium Nickel Iron Bronze Bars, Forgings and Stampings." It is hoped that these two standards will be used wherever aluminium bronze is required for general engineering purposes.

ELECTRO-PLATED COATINGS OF NICKEL AND CHROMIUM

No. 1224 : 1953. Price 2s. 6d. The principal reason for the revision of this standard is that the original document did not fully meet the requirements of the motor-car industry and it has been extended to cover coatings on materials other than steel and copper. The standard has been drawn up with a view to specifying the essential qualities of the coatings in question. It is realised that it is impossible at the present time to specify completely every factor affecting the performance of an electro-plated coating.

An important feature of this standard is the minimum thickness of the deposit and particular attention is drawn to the effect of the contour. The requirements for minimum thickness normally apply only to those portions of the significant surface which can be touched by a ball of 1in diameter, and the specification notes that manufacturers should allow this vital consideration of surface contour to influence the design of any article on which a durable electro-plated coating is essential. It has not been found possible to specify average thicknesses as they vary considerably with the size and shape of the article and the method of plating. It was also impracticable to give guidance on the usage of the various classifications due to the difference in requirements. It is also pointed out that the importance of conserving nickel has been taken into account in the preparation of the document by specifying alternative coatings using copper undercoatings.

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AUTOMOBILE DESIGN

As another Motor Show comes to its end it seems certain that once again more people than in recent years have visited Earls Court to see the impressive assembly of cars from all over the world. What is the main attraction of this, the world's greatest motor exhibition? As far as the average British motorist is concerned, he can visit the show as a potential buyer, encouraged by the good news that at this first covenant-free motor fair he should be able to choose a car and possibly obtain immediate delivery. He will undoubtedly admire the splendid luxury cars, and the sleek expensive sports models, but in the end his interest will centre round the new small " economy " cars which this year are being offered in greater variety than before. Apart from such potential buyers, however, there are many thousands of interested people, engineers, technicians, mechanics, some of whom may never have the means of buying a motor-car, yet who visit the show to study the exhibits in detail, especially the exploded models, with the eyes of experts or, at least, with the attention of ardent students of automobile engineering. These people are not very much interested in colour schemes, fittings and trimmings, nor perhaps do they fully appreciate the intricate points of elaborate æsthetic styling, but they are aware of the respective merits of general layout and technical detail work. Neither are they naive enough to expect revolutionary changes in design at each year's exhibition, for they know perfectly well that modern large-scale production methods make it imperative that a design, once chosen for production, has to remain static for several years. On the other hand, they remain unimpressed when meeting the same models year after year without any more alterations than maybe some minor changes in styling. There are exceptions, however, for there are cars, designed twenty years ago, which to-day are just as modern as they were when first marketed, while others of the same vintage are still as conventional as they were then !

In pre-war days the creative genius and the strong personality of some designers contributed enormously to the rapid technical development of the automobile industry. But, to-day, teams of anonymous designers, all specialist in one field of engineering or another, have to work together, with the result that the final products represent not the creation of some ingenious designer—although he still carries the ultimate responsibility—but a compromise concluded in a board room between the heads of the sales, export and production departments. There are said to be some groups of engineers and designers working in different factories upon problems of long-term design and development ; but it seems that so far little of their labour is reflected in the British exhibits this year. The men responsible for the future of the British automobile industry must be aware of the peril of stagnation which is attendant upon too conservative a policy. In an interview, published two years ago, Sir John Black was reported to give his opinion that one of the troubles with this country as far as cars go was that old ideas were constantly developed instead of breaking away into something new. He anticipated that an entire break with the present idea of cars would come soon, altering the whole conception of suspension, braking, road adhesion and general safety. We have no doubt that those responsible for the new models introduced this year have indeed considered the general specifications of their latest designs very carefully. From the very fact that they refrained from any bold approach to new engineering principles, it must be concluded that they seemed suspicious of the public's reaction to vehicles which differ considerably from the orthodox conception.

But is the public indeed as conservative as some sales managers assume ? Why should not a manufacturer of reputation be able to introduce some revolutionary new car, provided, of course, that the ideas incorporated in a new design have some decisive bearing upon the functional value of the vehicle. Since the war, some Continental cars, entirely unorthodox in character, have been marketed. They have been accepted by the public not only without reservation, but even with enthusiasm. The soundness of the mechanical principles involved and the advantages which can result from the sensible application of such constructions as independent rear suspensions, air-cooling, two-stroke engines, front-wheel drive or rear-engine mounting have proved sufficiently strong to outweigh any apprehensions which the public might have had. Nearly all these cars were designed from fifteen to twenty years ago, and, according to our present knowledge and experience, no longer represent the latest stage of technical development. However, they are still considered entirely modern, and so far as road performance, economy and comfort are concerned, they appear to be just as good or sometimes even better than some post-war designs. Those responsible for their construction were not content to cater solely for contemporary demands, but aimed to anticipate future requirements. We feel that a rather more adventurous spirit in automobile design is desirable in this country if the British motor-car industry wishes to retain its leadership in face of growing international competition.

DISTRICT HEATING

A very large mass of information is available about all facets of district heating. It is, indeed, a somewhat indigestible mass. For it is distributed amongst the pages of many technical journals, institution proceedings and governmental and other reports, and some of it is available only in foreign languages. Nor can we recall any convenient textbook that satisfactorily covers the whole subject. That is all the more surprising in that opportunities to apply district heating schemes in this country have never before been so widespread. There is inevitably difficulty, and usually increased cost, in attempting to introduce a district heating scheme into an already existing town. But during the war many of the centres of Britain's larger cities, including that of London itself, were so damaged by bombs and fire bombs that they have had to be cleared preparatory to complete redevelopment ; there are heavy arrears of house-building still to be made up, many of the houses being planned to be grouped into estates that could relatively simply be served by district heating schemes, and the development of new satellite towns offers further opportunities.

It is therefore very welcome that there should have been published on this subject, as No. 31 and No. 32 of the *Post-War Building Studies*, two volumes by a Sub-Committee of the Heating and Ventilation (Reconstruction) Committee of the Building Research Board.* The first volume consists of Parts I to V of the complete report on the subject. It contains a general report intended to present a picture of the possibilities and to summarise the more technical parts that follow, a survey of district heating practice abroad, memoranda on certain suggested schemes in this country, and a discussion of the heat pump. The second volume consists of Part VI of the complete report. It contains a detailed technical study based upon a single installation of a representative character of a

* H.M. Stationery Office. Prices 7s. 6d. and 10s. respectively.

thermal-electric scheme with hot-water distribution. The scheme is designed to serve 150,000 out of a total population in a typical town with 250,000 inhabitants, and is estimated to bring about a saving of 132,000 tons of coal per year while giving those connected 32 per cent more heat than they would otherwise have had. Unfortunately, at the time the study was undertaken the sub-committee was faced by rapidly changing costs of engineering materials and work. In the hope of overcoming this difficulty costs are based on the price levels of 1937 and need conversion to be relevant to the present day. From internal evidence within the reports it is quite clear that the work was actually completed not merely some months but some several years ago. It can only be regarded as very unfortunate, in view of the importance of the subject, that publication should have been so very long delayed. For the report urges that representative schemes, both thermal and thermal-electric, should be started in order that the necessary operating experience can be gained. Had the report been published earlier—even though the information it contains has been, in the interim, available to the Ministries particularly concerned—encouragement might have been given for the earlier establishment of a full thermal-electric scheme in, for example, one of London's new satellite towns. It is, indeed, very difficult to understand why publication has been so long delayed.

Necessarily, if district heating is to be distributed from thermal-electric stations, power stations will need to be erected in or close to urban areas. That would be a development contradictory to the general planning of the British Electricity Authority which appears to be thinking at present rather of placing future power stations far away from electricity consuming areas and closer to their fuel supplies. But such a contradiction in view surely suggests that an experiment ought to be conducted as soon as possible with a full and large-scale thermal-electric heating scheme so that practical working costs and real figures for economy in coal usage could be worked out. Small-scale schemes are not very satisfactory for the purpose as it is one of the broad conclusions of the report that the cost of heat is related inversely with the size of the scheme. Purely thermal district heating schemes, of which several have been or are being developed in this country, can, of course, give practical experience of distribution and control problems and more certain figures than mere estimates of fluctuations in demand. But, Pimlico (this scheme was described in THE ENGINEER, July 27, 1951) excepted, a scheme which the sub-committee does not regard as typical, no thermal-electric schemes are being developed, figures for which could be compared with the thermal schemes. Nor, except at Pimlico, will the British Electricity Authority gain any experience of the operation of a thermal-electric plant. Perhaps the story in this country will follow the same lines as in later American experience. There, after much experience with thermal-electric plants the increase in electricity demand led to the building of new stations too far from the potential heating load to make thermal-electric heating practicable. District heating was thereafter maintained by central thermal stations. Latterly, however, with the modernisation of the Waterside No. 1 and No. 2 generating stations at New York, much higher steam pressure is being used and it is exhausted at 200 lb per square inch pressure to the district heating mains. Perhaps when the time comes to modernise power stations in Britain's cities, a similar opportunity will be taken. It is to be noticed, however, that in New York the district heating mains were already in existence. That, no doubt, was a material factor in making the adoption of thermal-electric generation economic.

Obituary

W. A. VIGNOLES

WE regret to have to record the death of Lieut.-Colonel Walter Adolph Vignoles, D.S.O., M.I.E.E., which occurred on Saturday last, October 24th, at Fair Acre, East Horsley, Surrey. Colonel Vignoles, who was in his eightieth year, had had a long association with the firm of Evershed and Vignoles, Ltd., Acton, London, W.3, of which he had been joint managing director. He retired from the board a few years ago.

W. A. Vignoles received his technical education at the Finsbury Technical College, and his early practical training with W. T. Goolden and Co. Subsequently, from 1895 to 1899, he was engaged in the drawing-office of Crompton and Co., Ltd.—now Crompton Parkinson, Ltd.—at Chelmsford, and before leaving there had succeeded to the position of chief draughtsman. Colonel Vignoles then joined the staff of the late Sir Alexander Kennedy, acting as resident engineer for the erection of the Grimsby power station from 1899 to 1901. In the latter year, he was appointed electrical engineer to the Grimsby Corporation, in which position he continued for twenty-six years, apart from the period of the first world war, during which he was on active service in France. Colonel Vignoles left Grimsby in 1927 to become Director of the British Electrical Development Association. He joined the board of Evershed and Vignoles, Ltd., in 1928, and relinquished his directorship of B.E.D.A. in 1930 on being appointed joint managing director of Evershed and Vignoles, Ltd. Ill-health compelled him to retire from that office in 1941, but he continued to serve as a director of the company for several years afterwards.

Colonel Vignoles had served on the council of the Institution of Electrical Engineers and on the council of Beama. In addition, he took an active part in the work of the Incorporated Municipal Electrical Association, of which he was president in 1922–23.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

ROLE OF EXPERIMENTS IN APPLIED SCIENCE

SIR,—Professor Pippard, in a letter to you dated September 18th, set out his views regarding the role of experiments in applied science, and expressed strong agreement with my contention that this question is important. He has given an admirable lead to a discussion which I hope will be wide and general; but here, since his letter dealt specifically with a question that I raised in a review of his book, I confine myself to that issue and maintain my anonymity. I regret that indisposition has prevented an earlier reply.

My concern, in what I wrote, was with his category (*b*)—Confirmatory experiments made after analysis. I specifically excluded experiments used in teaching, admitting that these can help students to comprehension of a theory. On that ground alone I would urge the need of well-equipped engineering laboratories; and equally I would accept Professor Pippard's contention that what is true of students is true of many practising engineers. All honest means to persuasion are surely justified: none-the-less, the philosophical question still remains unanswered: under what conditions, in a strict analysis, do confirmatory experiments reinforce a theoretical treatment?

As I see the matter, before that question can be answered we must have clear notions as to what disagreement would imply; and I would answer: "Not when the experiments are designed to fulfil every simplifying assumption that is made in the theory"; because lack of agreement, then, is to me unthinkable unless as resulting either from faulty experimental technique or from errors in computation. Of agreement, in the circumstances I have mentioned, two interpretations seem to be possible: either (1) the experiment has been used to verify the accuracy of computations which can be checked more easily and more reliably in other ways; or (2) what has really been established is the soundness of the experimental methods—the accuracy of the computations is assumed.

I had also meant (in the nature of the case) my remarks to be confined to structural experiments; and in this connection I add something, now, about Professor Pippard's category (*c*)—Experiments made in conjunction with analysis to provide essential data or to obtain empirical formulas. The strut, which he chose as an example of this class, is an excellent example of my thesis: that experiments made in parallel with theoretical treatment have real value only when they take account of factors (e.g. of rigid joints as actually fabricated) which theory is compelled to disregard, or of factors, like the variability of real materials, which are beyond the power of theory to assess. For a strut may be tested, in category (*c*), either (1) as a component, too complex for theoretical treatment, of a structure too large to be tested in its entirety or (2), as in Robertson's tests which Professor Pippard cites, with the aim of obtaining knowledge of a factor shown by theory to be important but beyond the power of theory to predict. In neither case, I would say, does the experiment duplicate theory; and the excellence of the example, from my standpoint, lies in the fact that (at least, within the elastic range) the theory of a strut's behaviour is almost exact—and explains the large effect of small inaccuracies which in practice are unavoidable. If the initial form of the centre-line were exactly known, there would be (for a uniform section) no need to experiment: in practice it is not known, but experiments interpreted by theory have put bounds to the imperfections which must be allowed for.

In sum, my concern thus far has been with the complementary roles of theory and experiment. I have nothing now to remark in relation to categories (*a*), (*d*) or (*c*), which I take to be cases in which theory is non-existent either because it presents too great difficulty or because it is not worth while.

"YOUR REVIEWER"

October 20th.

AUTOMATIC TRAIN CONTROL

SIR,—In your editorial of October 23rd you mention that no accidents had occurred to your knowledge on the Western Region through irregular cancellation of the A.T.C. warning indication. However, while this may be correct,

instances have occurred on the G.W.R., the most serious of which was at Norton Fitzwarren in 1940. The driver thought he was on the main line when in fact he was on the slow one, the train being subsequently derailed at the trap points protecting the junction of the two. Although I have been unable to locate them, I have a distinct recollection of further references to similar irregularities, which were fortunately without such serious consequences. I believe that safety side failures of the G.W.R. equipment are not all that infrequent, which would lead to difficulties if the driver were stopped from regaining control until speed had been reduced to a certain figure. Another point of interest is that the Western Region authorities have received complaints that the operation of the ramps as an engine passes causes interference with television ! One wonders what the effect of the new standard magnetic system will be by comparison.

I was recently re-reading the letter by Mr. Munnion in your issue of July 3rd, in which he doubts whether any change was made in the valve settings of the A1 " Pacifics," as mentioned by Mr. Nock. In the summer of 1949 I travelled to Darlington on the " Tees-Tyne Pullman " behind the first of these engines " W. P. Allen." At that time the schedule of the train was very much slower than it is at present, but even so time was dropped with the normal load of 320 tons. With four out-of-course checks of varying severity the 232 miles required 261¼ min. This early performance certainly did not come up to subsequent standards for the class, when, with the corresponding up train, speeds of 90 m.p.h. on the level have been achieved and an overall net time of as little as 224 min—21 min less than that scheduled.

P. W. B. SEMMENS

Middlesbrough, October 25th.

THE " SONIC " BOOM

SIR,—Unlike Mr. Tuplin, whose letter in your issue of October 16th I read with considerable interest, I have been fortunate enough to hear many examples of sonic " booms." In each case I have been struck by the total dissimilarity between the nature of the " boom " and the sound of an aircraft engine. This applies equally throughout the range of " booms " from the sharp double crack to the low and prolonged rumble.

This has led me to wonder whether, in fact, the " boom " has anything to do with the sound of the aircraft, or whether it is related to some purely explosive physical phenomenon attending passage through the so-called sonic barrier. All who have heard these sounds will, I think, agree that they are purely explosive in character.

Two points I would mention in support of this possibility : first, the " booms " are often heard from aircraft flying at an altitude at which their engine sound would be quite inaudible from the ground, and, secondly, the nature of the " boom " is entirely different from the sound heard by an observer when an aircraft flies very closely past him, at very low altitude and at near-sonic speed. This latter, though in the form of a sudden crash of sound, is still aurally obvious as aircraft noise.

P. W. LOVEDAY

Ripley, Surrey,
October 21st.

Books Received

Modern Pumps. By E. Molloy. London : George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. Price 21s.

Simplified Drafting Practice. By W. L. Healy and A. H. Rau. London : Chapman and Hall, Ltd., 37, Essex Street, W.C.2. Price 40s.

Pipefitters' Handbook. By Forrest R. Lindsey. London : Bailey Brothers and Swinfen, Ltd., 46, St. Giles High Street, W.C.2. Price 51s.

International Motor Show

No. II—(*Continued from page 533, October 23rd*)

MENTION of the car introduced by the Austin Motor Company, Ltd., concludes our report of the small cars exhibited at the Motor Show, which closes to-morrow.

It is a two-door version of the well-known " A30 " saloon, and becomes now the cheapest post-war model in this country. This car (Fig. 5) meets the requirements of those who seldom travel four up and do not consider easy access to the rear seats a primary consideration. It is similar in appearance to the four-door model which it supplements ; by using tubular seat frames it has been possible to increase the head room over the front seats and the width of the latter. A considerable increase in knee-room has also been obtained by altering the location of the heater unit.

So far in this report prominence has been given to the small car the development of which has assumed considerable social and economic significance. It must be admitted, however, that, important as this particular trend is, it is easy to get it out of perspective. These " baby " cars now demand a lot of attention, but it must not be overlooked that there are other members of the family to consider ! Equally vital are the medium-size popular cars which, in volume, make up the largest part of our export trade, the numerous sports models and " convertibles " for which sales have greatly increased in recent months, and the specialist cars—the quality automobiles—which *per capita* earn so much foreign currency from all parts of the world. Although a healthy home market is essential to support and supplement our substantial export trade, the latter is still our primary concern, and it would be most unfortunate if economic circumstances at home forced the industry to concentrate unduly on small engines and vehicles of mainly utilitarian character.

At present, however, and particularly from impressions gained at the Show, there seems no justification for a pessimistic outlook. The large and middle-sized cars still form the majority of all exhibits, and there is still a sufficiently great number of potential buyers who, sometimes for reason of prestige and " keeping up appearances," are not prepared to accept vehicles which fall considerably short of the standards set by larger and more expensive models. Considering first British cars of the medium and higher price class, we find at the various stands numerous new attractive models some of which are to be briefly described.

At the stand of the Daimler Company, Ltd., are two new models, the 2½-litre " Conquest " saloon and the " Conquest Roadster." The " Conquest," having been introduced to the home market in May of this year, makes its first appearance at Earls Court, while the " Roadster," an entirely new car, is being shown for the first time. Both cars are fitted with the well-known 2·5-litre six-cylinder, long-stroke engine, and the transmission incorporates the Daimler fluid flywheel and the pre-selective epicyclic gearbox. The " Roadster " (Fig. 6), mounted on a special series " Conquest " chassis, has a modified engine, differing from the standard engine in having larger valves, a high-lift camshaft and dual carburettors. By raising the compression ratio to 7·75 : 1 (as compared with 7 : 1 on the standard engine) and the engine speed, it has been possible to increase the output from 75 b.h.p. to 100 b.h.p. at 4600 r.p.m. It is anticipated that the performance of this new car will be something quite out of the ordinary for Daimler cars and the manufacturers are confident that the top speed of the standard production model will be well in excess of 100 m.p.h.

Fig. 5—Austin " A30 " Two-Door Saloon

The Lanchester Motor Company, Ltd., is showing the new " Dauphin," a sports car for four people only with separate front bucket seats and two tip-up armchair rear seats. The body is a two-door saloon in lightweight construction, consisting of a framework of light-alloy castings panelled in aluminium which is also used for the wings. The six-cylinder engine is similar in design to that of the Daimler " Conquest " ; it develops 92 b.h.p. and should give this light, streamlined car a road speed around 90 m.p.h.

The Nuffield Organisation has two new models on show. At the stand of the M.G. Car Company, Ltd., there is the new " Magnette " saloon, a car of integral construction fitted with a four-cylinder, 1·5-litre engine, which, incidentally, is the first new power unit to be produced by the recently formed British Motor Corporation. The push-rod operated o.h.v. engine of 73mm bore and 89mm stroke has the moderate compression ratio of 7·15 : 1 and

develops the very useful output of 60 b.h.p. at 4600 r.p.m. The front wheel suspension, employing wishbones and coil springs, is interesting because of the extensive use of rubber bushes, which considerably reduces the number of grease nipples. The rear suspension comprises a live axle and half-elliptic leaf springs ; it is unusual in as far as the axle casing is not attached to the springs by means of U-bolts, but is flexibly mounted with the help of rubber bushes.

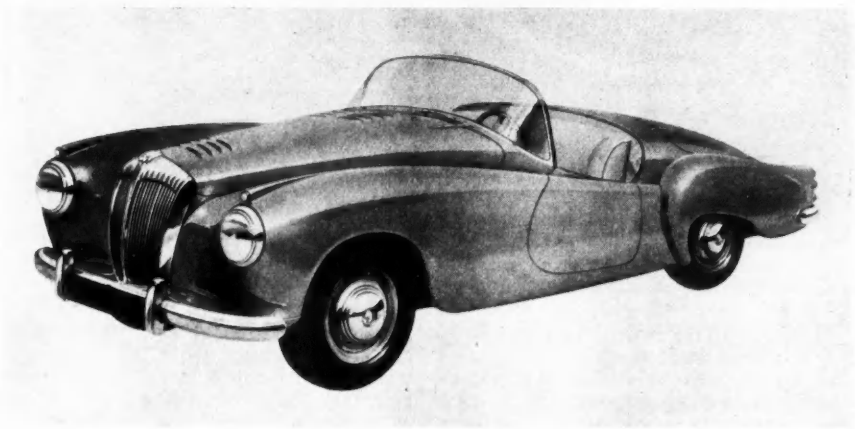


Fig. 6—Daimler "Conquest Roadster"

As the springs cannot take torque reactions, a torque arm is bolted to the axle casing and attached at its forward end to the body framework.

The other new car, marketed by the Nuffield Organisation, is the "Pathfinder" (Fig. 7), made by Riley Motors, Ltd., a spacious saloon of pleasing and imaginative body design which is capable of a maximum speed of about 100 m.p.h. The 2½-litre engine, of 80·5mm bore and 120mm stroke, is an improved version of the "Big Four" Riley engine and has hemispherical combustion chambers, twin high camshafts, short push-rods and rockers. By stepping up the compression ratio to 7·25 : 1, compared with 6·8 : 1 of the previous engine, with some modifications to the pistons, the ports and the twin carburettor inlet manifold, the output has been raised to 110 b.h.p. at 4500 r.p.m., equivalent to 44 b.h.p. per litre, an output which is exceptionally high for a large, long-stroke, four-cylinder engine. The transmission unit, consisting of a four-speed gearbox, an open propeller shaft and a hypoid bevel rear axle, is conventional, but the gear lever is mounted on the floor of the car. It is recessed into the seat on the offside and provides remote control in a simpler and more positive way than most steering-column gear-shift linkages.

The front suspension employs an upper wishbone assembly in conjunction with torsion bars and telescopic spring dampers. The rear suspension system does away with the conventional leaf springs and supports the weight of the car by coil springs with telescopic dampers which are concentrically mounted inside the springs. The lateral location of the axle relative to the chassis is maintained by a transverse Panhard rod, while the drive and braking torque are taken by a pair of radius arms which extend forwards and inwards towards the car centre line. By pivoting these two radius arms in rubber bushes close together on either side of the propeller shaft, the suspension layout has sufficient flexibility to follow the movements of the rear axle. Like previous Riley cars, the "Pathfinder" has a servo-assisted hydraulically operated brake arrangement with two trailing shoes in front and leading and trailing shoes at the rear.

Two new models, the four-cylinder "60" and the six-cylinder "90" are to be found at the stand of the Rover Company, Ltd., the type numbers indicating the horsepower of the engine. The cars, apart from the engine, are in every other respect identical with the previous Rover "75," the manufacture of which is being continued. Rover cars, therefore, will now be available with three different engines, a 2-litre, four-cylinder of 60 b.h.p. (Fig. 8), a 2·1-litre, six-cylinder of 75 b.h.p., and a 2·6-litre, six-cylinder engine of 90 b.h.p. All these engines have overhead inlet valves and inclined side exhaust valves. In view of the fact that this valve arrangement was originally chosen to obtain the optimum power output from high-octane fuel, it is interesting to note that the compression ratio of the newly introduced engines has been reduced to 6·73 : 1 compared with 7·25 : 1 of the type "75."

Rover cars are the only British cars which still retain a free-wheel device to assist fuel economy. Another interesting detail of the latest models is the return to the central gear-shift (Fig. 9) lever instead of the previously used steering column control ; the gear lever is so arranged that three people can be comfortably seated on the bench front seat.

A new high-performance sports car, the Sunbeam "Alpine," is being displayed at the stand of Sunbeam-Talbot, Ltd. It was introduced a few months ago for North America and other overseas markets, and is now available for the home market. Based on the successful Sunbeam-Talbot "90," it incorporates a number of modifications and refinements. The push-rod-operated o.h.v., four-cylinder engine of 2·6-litre capacity is basically the same as that of the "90," but for the purpose of improving the breathing capacity of the engine shorter valve guides have been fitted and the inlet ports have been enlarged. These modifications, combined with an increase of the compression ratio to 7·42 : 1, have resulted in stepping up the maximum power output to 80 b.h.p. at 4200 r.p.m. with a maximum torque of 124 lb-ft at 1800 r.p.m.

Another entirely new sports model is the "Jupiter R4" of Jowett Cars, Ltd., a modification of the Mk. IA form, which was noticed at last year's show. The 1½-litre horizontal flat, four-cylinder has now a compression ratio of 8·5 : 1, which has raised the output to 65 b.h.p. at 5000 r.p.m. The radiator is located above the clutch housing at the rear of the engine. In order to overcome the difficulties of a belt-driven fan, arising from the unusual position of the radiator, an electrically driven and thermostatically controlled fan has been mounted behind the radiator. This arrangement, so far known only in some Continental rear-engined buses, is slightly heavier than a belt-driven fan, but it has the advantage of keeping the engine temperature constant within very narrow limits. A further modification is the replacement of the previously used torsion bars and trailing arms at the rear suspension, in favour of the more conventional semi-elliptic leaf spring arrangement. Another characteristic feature of the Jowett cars—the tubular structure of the chassis—has also been abandoned and replaced by strong box-sectioned pressings, stiffened by a welded-on body shell. An over-speed gear, mounted between two cross members, divides the propeller shaft into two sections and now provides four gear ratios. As a result of these modifications this interesting small sports car has now proved capable of reaching a maximum speed of more than 85 m.p.h.

When trying to distinguish the technical trend in the design and construction of British motor-cars, one notes that, with the exception of the new models already mentioned, there were not many outstanding departures from orthodox practice. Nearly all the new designs, in their particular class, represent excellent examples of contemporary automobile engineering, but when trying to find something which could give an indication

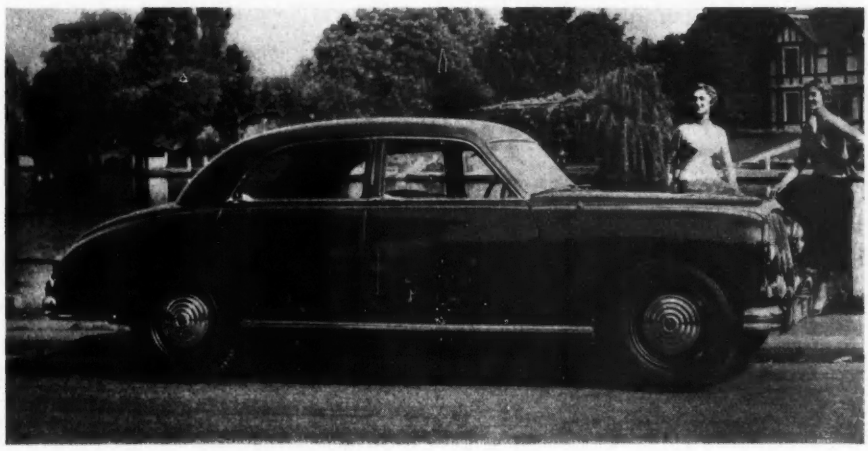


Fig. 7—Riley 1·5-Litre "Pathfinder"

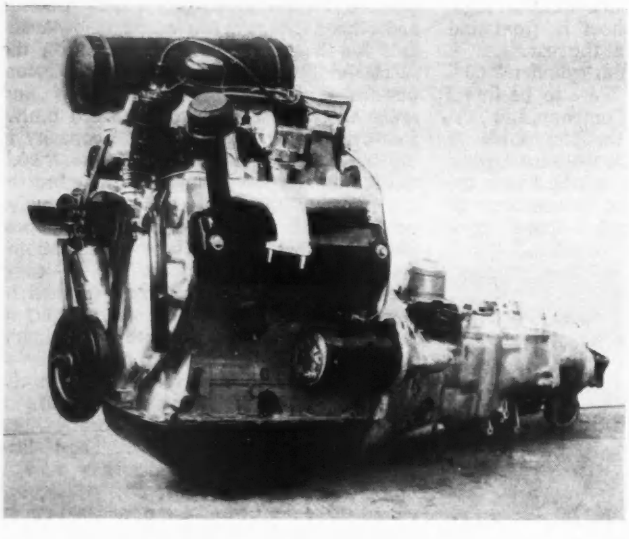


Fig. 8—Rover Four-Cylinder "60" Engine

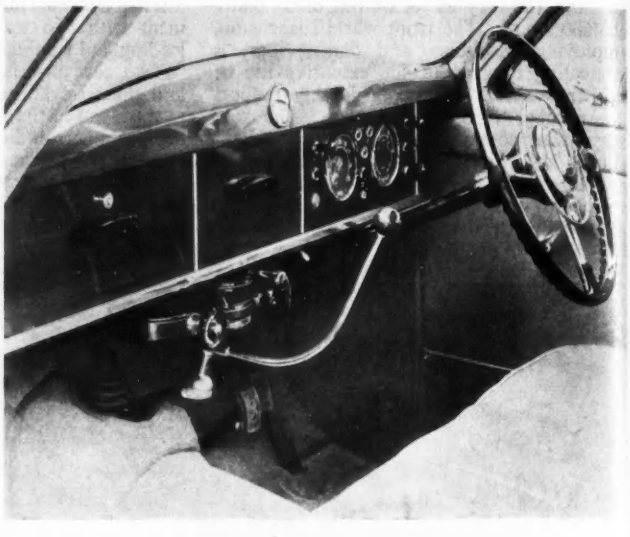


Fig. 9—Rover Gear-Changing Linkage

of the "shape of things to come," one might feel slightly disappointed. It might seem that this country still wishes to retain a conservative approach amidst a changing world of foreign development. Nevertheless, we notice with satisfaction a considerable number of detailed developments which are bound to be of value to the user and contribute to the all-round merit of the design.

Turning now to the basic engineering trends which govern the layout of British cars, we find that the greatest improvements have been made in the construction and the styling of bodies, particularly that of fast-touring and sports cars. The public, sometimes rather slow in appreciating changes, has now accepted with little reservation the typical low, wide body shape with its horizontal air intake at the front, not only because of its inherent practical advantages, but in realisation that it represents indeed a great improvement in appearance. There are still some cars left where the body designer, with more or less success, has tried to blend with the modern wide body some ornamental front grille, reminiscent in shape of the traditional radiator that used to distinguish the make. The general trend, however, is towards an elimination of the gully between the bonnet and the wings so that the front of the car tends to be more box-like in form and, therefore, more like the rear end. There is no doubt that by balancing the bonnet length with that of the luggage boot at the rear, a definitely pleasing effect, coupled with some real practical advantages (large rear window, sufficient luggage space, &c.) has been attained. It is almost customary now to use curved windscreens which is valuable both in increasing the driver's angle of view and avoiding disconcerting reflections. Similarly, full-width curved glass at the rear of the car further emphasises the symmetry of its silhouette.

Instruments are generally better arranged, being grouped for easy reading in a hooded binnacle immediately ahead of the driver between the two-spoked steering wheel. Foam rubber and "Dunlopillo" cushions are more widely used, as are seats upholstered with plastic fabrics; the new Standard "Eight" and the Humber "Hawk" Mk. V are equipped with "Tygan" upholstery, woven from a thermo-plastic filament, which is resistant to rot, mildew and moths, and can be easily cleaned with a damp cloth.

Practically all the modern bodies, as far as they are being made in large-scale production, are of the integral stressed-skin construction and are interesting examples of good design combining a maximum of stiffness with a minimum of weight.

Integral construction, of course, is only suitable for manufacturers with well-equipped press shops and welding installations and necessitates considerable investment in expensive jigs or tools. It is almost entirely used by firms which specialise in making large numbers of comparatively few models and is not sufficiently economical for manufacturers who cater for a greater variety of body styles. Some of these firms are reported lately to have experienced difficulties in obtaining steel bodies since the two largest body-producing firms, Briggs Motor Bodies, Ltd., and Pressed Steel Company, Ltd., have been acquired by Ford Motor Company and the British Motor Corporation respectively. The

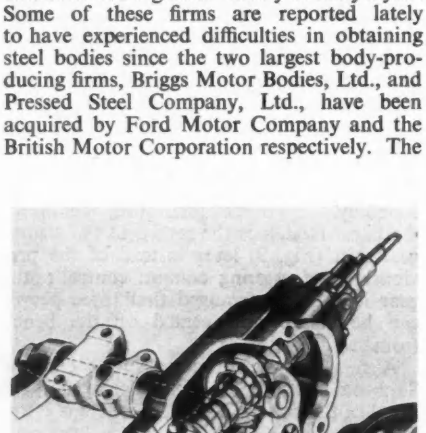


Fig. 10—Burman Steering Gear

appearance of two open sports cars, a Jowett and a Singer, both fitted with British-made plastic bodies, has therefore attracted much interest. Plastic material, so far, has been employed in the British motor industry for secondary uses only, as instrument boards, filler caps, small covers, &c., while in U.S.A. at least one production model, the Chevrolet "Corvette," fitted with a mass-produced plastic body, has been coming off the assembly lines in limited numbers since January of this year. French manufacturers are also optimistic about the prospect of this development. It seems unlikely, however, that plastic materials will ever be used as structural material for integral bodies. On the other hand, there is little doubt that they will be increasingly employed for lightly stressed bodies if mounted on a conventional chassis of sufficient rigidity and, of course, for such parts as wings, bonnets, luggage boot covers, &c.

An interesting example of an all-plastic body is that shown mounted on a standard export roadster chassis on the stand of Singer Motors, Ltd. The gracefully styled two-door, four-seater body is externally indistinguishable from a steel body. It is constructed from polyester resin, reinforced by glass fibre and consists chiefly of two big mouldings. The front section, incorporating the bonnet and the wheel arches, is moulded in one piece and, being hinged to the front cross member, can be tilted upwards and forwards to provide unrestricted access to the engine. The rear moulding extends backwards from the trailing edges of the doors and includes the rear wings and the luggage compartment. Other sections comprise the scuttle, carrying the windscreen, the two doors, the instrument panel with the glove boxes and the spare wheel cover. The floor is of light alloy bonded to the body shell and the body itself is bonded to tubular steel members which reinforce the plastic components and bolted to the chassis. The advantage of synthetic resin as body material, over steel, is its lighter weight, amounting in the above case to a saving of about 1 cwt to 1½ cwt. It withstands impact which would dent a steel panel and if fractured it can be repaired by trimming the edges of the broken part and applying a patch of self-setting plastic material.

In the case of engine development there is little to report. No new "square" or "super-square" engines or engines with hemispherical combustion chambers have been introduced to the British market but, in the process of steady evolution, the output of existing engines has generally been increased, sometimes by as much as about 10 per cent. The premium grade fuels of high octane rate, now freely available in this country, have allowed manufacturers to raise the compression ratio, thereby increasing the brake mean effective pressure and improving the fuel consumption. In some cases the engine speed also has been stepped up by modifications to the shape of combus-

tion chambers, bigger inlet valves, " streamlining " of the ports, controlled water flow, &c., with the result that quite a number of modern standard production engines develop about 35 b.h.p. per litre, and high-performance engines for sports cars up to 45 b.h.p. per litre.

The design of clutches and gearboxes has remained practically unaltered. More manufacturers have adopted the hydraulic operation of the clutch withdrawal mechanism, and there is an increased tendency towards fitting the Laycock-de-Normanville overdrive gearbox as an optional extra to some cars, especially sports models. For the purpose of shortening the length of the propeller shaft, the gear output shaft is now frequently extended and supported in an additional bearing, mounted in a rear extension of the gearbox casing. Steering column gear-shift control is the rule except in the case of small cars where the centre lever does not interfere with the free movements of the two people who can be accommodated on a front seat of limited width. Some designers are of the opinion that the present system of steering column control is not entirely foolproof, and is likely to become subject to lost motion and rattle. For this reason two manufacturers have introduced a modification of the conventional gear lever, i.e. a lever, conveniently mounted on some bracket on the floor, and connected with gear-shift selector at the gearbox by some simple linkage. It is claimed that this system provides a more positive remote control than the steering-column gear shift.

Rigid rear axles, generally of the hypoid bevel gear type, are the rule, and the " Lagonda " and the " A.C." sports two-seater are the only British cars which employ a final drive casing rigidly mounted to the chassis, in conjunction with universally jointed half-shafts and independently sprung wheels.

With regard to front suspensions, it seems that coil springs, as a rule with concentric telescopic dampers and triangular wishbones, are the most popular layout and are slowly supplanting other arrangements as torsion bars and transverse leaf springs. Rear suspensions, with very few exceptions, are of the orthodox kind, employing leaf springs for supporting the weight of the car as well as for taking the drive and torque reactions. From the fact that Jowett has relinquished the previously used arrangement of torsion bars and radius arms in favour of the orthodox leaf spring layout, while Riley, in its " Pathfinder," adopted coil springs instead of leaf springs, it appears that designers differ in this matter. From a theoretical point of view, however, coil springs or torsion bars are definitely preferable to leaf springs ; they not only deal adequately with bigger road irregularities, but greatly reduce the high-frequency vibrations because they are free from the built-in friction inseparable from leaf springs.

The steering layouts have changed very little ; steering boxes are either of the cam-and-peg or cam-and-roller type, while light cars and sports cars are frequently equipped with the rack-and-pinion steering. Some cars, among them the " Wyvern " and " Velox " of Vauxhall Motors, Ltd., have recently adopted the Burman recirculating ball steering gear (Fig. 10), which lessens the internal friction and reduces the steering effort, especially at very low speed.

No new development is to be observed in brake design, the usual layout comprising hydraulically operated brakes with two leading shoes at the front and leading and trailing shoes at the rear. Only a few fast and heavy cars employ servo-assisted brakes. Brake drums are generally made of cast iron, but here, again, several sports cars incorporate in their design heavily finned aluminium drums with ferrous liners, and heat dissipation from the brakes is assisted by the use of air scoops or ventilated wheels.

Disc brakes, as introduced by Girling and Lockheed last year, have not yet found more general application, and, for the time being, they are confined to non-production models and competition cars.

(*To be continued*)

Sectional Paper Machine Drive with Electronic Control

A new Fourdrinier papermaking machine is in operation at the mill of the Guard Bridge Paper Company, Ltd., near St. Andrews. The machine is driven by electric motors with electronic control of the sectional drives, as described here.

ON Wednesday last we paid a visit to the mill of the Guard Bridge Paper Company, Ltd., near St. Andrews, Scotland, to see a new Fourdrinier paper machine in operation. This machine has a wire width of 122in and an operating speed range of 40ft to 400ft per minute and it is designed for the production of a variety of fine writing papers. The paper machine itself was supplied by James Bertram and Son, Ltd., Edinburgh, and the complete motor drive equipment, together with its electronic control gear, was supplied by the British Thomson-Houston Company, Ltd., Rugby.

The machine, which is arranged in seventeen sections, is shown diagrammatically in Fig. 1, the places at which driving power is applied being indicated by arrows. We precede our description of the electronically controlled sectional drive by a brief outline of the papermaking machine itself.

The stock chests are tile lined and fitted with Bell's agitators, above which is a " Leith Walk " rotary " saveall " which deals with the machine whitewater and couch trimmings and discharges the recovered fibre directly into the chests. Final clearing of the stock is carried out by two No. 1 size " Jones " high-speed refiners, which are manufactured under licence by James Bertram and Son, Ltd. Cleanliness being of great importance in the manufacture of quality paper, a six-unit Vickery " dirtec " system and six Purifuge centrifugal separators are installed. They are followed by two " Leith Walk " drum strainers, having stainless steel drums and diaphragms and acid-resisting tile-lined vats.

The specially designed double-vee breast box (Fig. 1) is of stainless steel construction and is fitted with an adjustable deckle head and flexible slice to control the flow of stock to the wire. The wire is 122in wide by 70ft 5in long, the supporting table rolls and under-wire rolls being equipped throughout with labyrinth-sealed ball bearings. " Leith Walk " vertical shake motion is applied. The dandy (Fig. 1) is motor driven and, like the main drive, is electronically controlled. Most components of the wet end are chromium plated, fescolised, or made in stainless steel to resist corrosion.

A suction couch roll with single box is followed by an adjustable blow roll before the first press felt. The wet press section of the machine comprises two presses, the first being of the straight through suction type and the second a plain reversing press. The granite top rolls are carried in roller bearings in spherical housings and are supported in cast steel levers equipped with double-acting air cylinders for applying pressure as well as raising clear when changing felts. Vickery oscillating doctors and felt conditioners are used on both presses. Beyond the second press is a continuous web weighing machine, which immediately indicates any variation in substance of the sheet.

Ease of leading and clean outline are characteristics of the specially designed hollow section cylinder framing. The drying cylinders are 5ft in diameter and are fitted with large-capacity collar oiling bearing blocks, the oil level being controlled from an accessible header tank. The dry felt rolls, like the wet felt rolls, are vulcanite covered and run in ball bearing housings. Six felt drying cylinders in corrosion-resisting steel are fitted for the first three top and bottom dry felts, and are carried in roller bearing housings. The vapour absorption plant employs the hollow cylinder framing instead of outside ducting, while the hood is of aluminium panelling on a steel framework.

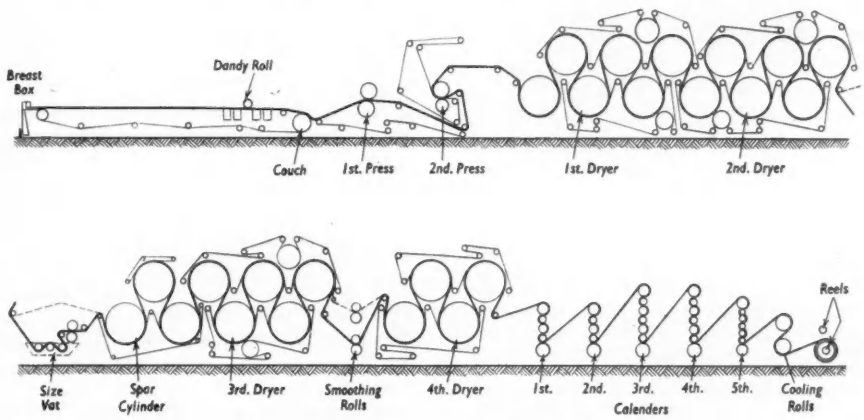


Fig. 1—Diagrammatic Arrangement of Machine

The size immersion bath and press are followed by three sparred drums built up from cast iron cylinders and longitudinal copper tubes. Further along the machine is a combined smoothing and damping roll stack, each pair of rolls being separately driven through enclosed gearing.

The machine incorporates five stacks of calenders, each having pneumatic pressure equipment, and motor-operated gear for raising the rolls. All rolls are fitted with Vickery doctors, and " Leith Walk " water doctors are fitted on the second and third stacks. They are followed by two cast bronze cooling drums and a two-spindle reeler, which is driven by two separate electronically controlled motors, providing automatic tensioning of the reels.

Master and Section Controls

The master control pedestal (Fig. 2) is installed in a position from which the whole front of the machine is visible. So long as the " Raise " or " Lower " push-button is kept depressed the

speed of the machine as a whole will increase or decrease at a slow, controlled rate. A dial indicator shows the actual speed of the first dryer section, in feet per minute. The other dial on the pedestal is a preset speed indicator, showing the speed level to which a section will accelerate after being started. There is an emergency "Stop" button whereby the whole machine can be shut down from the master control pedestal.

The operators' section control stations are housed in watertight boxes mounted on the front or back of the machine, as convenient. The controls consist of an "Inch" push button, a "Crawl-off-run" control switch, and a draw-control handwheel with scale. An ammeter indicates the load on the section motor. So long as the "Inch" push button is depressed the section drive runs at a slow preset speed. By

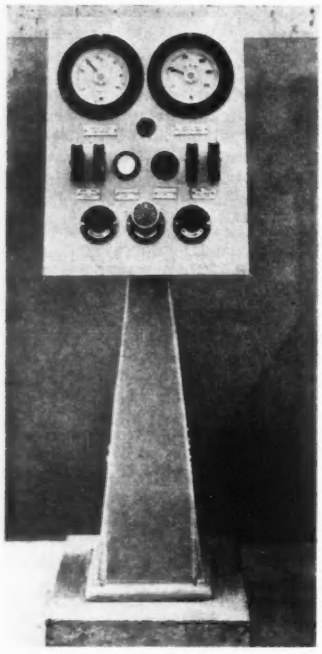


Fig. 2—Master Control Pedestal

setting the control switch to "Crawl" the section is kept running at the same slow speed until the switch is returned to the "Off" position. When the control switch is set to "Run" the section accelerates uniformly until it reaches paper-making speed as determined by the master speed control and the section draw control. On turning the control switch to "Off" the section is brought to rest.

On this installation a special arrangement is provided for the draw control. Operation of a standard draw control handwheel on the right-hand side of each control box adjusts the speed of the section concerned. There is also a draw control switch; when operated it causes a gradual change of speed of the section concerned and simultaneously of all the subsequent sections.

Sectional Drive and Control Arrangements

A simplified schematic diagram of a typical section of the multi-generator sectional drive is reproduced in Fig. 3. Each section is driven by a d.c. motor (1) with constant excitation. Each motor armature is supplied from its own Ward-Leonard generator (2), which is excited by a grid-controlled bi-phase thyratron rectifier. A small tachometer-generator (4) is coupled to the section motor and generates a voltage proportional to the section speed. This voltage is compared with the voltage of a reference busbar (3) and the difference is applied to a valve amplifier (5) which controls the firing of the generator field thyratrons. This arrangement constitutes a feedback regulating system, with amplification high enough to ensure that the difference between the feedback voltage from the tachometer-generator and the reference voltage is kept very small.

The speed regulating action of this control scheme is not accompanied by any mechanical movement and the associated inertia effects. Rapid response is therefore achieved and wear of moving parts is eliminated. The sensitivity of the regulating system is such that the speed change between sections due to all causes—

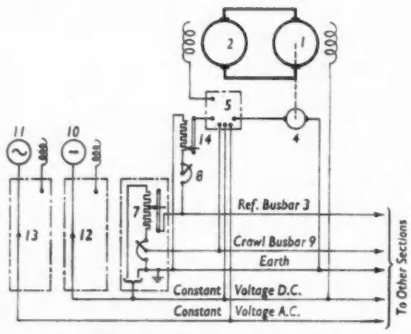


Fig. 3—Simplified Schematic Diagram of Sectional Drive

including load and temperature fluctuations—is less than 0·1 per cent.

The voltage of the reference busbar (3), which is common to all sections, forms the link that rigidly ties together the speeds of the various sections. The speed of the machine as a whole is altered by adjustment of the motor-operated master rheostat (7) which supplies the reference busbar (3). The speed of a section relative to the others may be accurately and rapidly adjusted by operating a small draw rheostat (8) in the section control station to modify the reference voltage for that section. A "Crawl" busbar (9) provides a low-voltage reference for inching and running at "Crawl" speed.

Stable d.c. and a.c. supplies, to ensure satisfactory operation of the speed regulators despite variations in the supply frequency and voltage, are obtained from an exciter (10) and alternator (11), each controlled by its own electronic voltage regulator (12) and (13) respectively to within ±0·2 per cent. The exciter supplies motor fields and contactor control gear, as well as the 300V d.c. supply for the electronic regulators. The 480V alternator supplies all the a.c. power required by the electronic control equipment.

A motor-operated section starting rheostat (14) enables each section to be accelerated at a controlled rate by smoothly transferring the reference for the speed regulator from the "Crawl" busbar (9) to the reference busbar (3).

All sections are driven by forced ventilated geared motor units. Those for the calenders are shown in the foreground of Fig. 4. Each calender is driven by a 30 h.p. unit with a 10 to 1 speed range at constant torque, through a gear-box with a ratio of 1400 : 69 r.p.m. A flange-mounted tachometer-generator on each drive unit (Fig. 5) is the only equipment required at the back of the paper machine for speed control.

Table I.—*Ratings and Gear Ratios of Section Motors*

Section	Motor h.p.	Gear ratio
Couch	30/4·5	1400/116
First press	15/2	1400/122
Second press	15/2	1400/68
First dryer	20/3	1400/77
Second dryer	20/3	1400/77
Size vat	10/1	1400/93·5
Spar cylinder	15/2	1400/75
Third dryer	20/3	1400/77
Smoothing roll	10/1	1400/93
Fourth dryer	15/2	1400/75
First calender	30/4·5	1400/69
Second calender	30/4·5	1400/69
Third calender	30/4·5	1400/69
Fourth calender	30/4·5	1400/69
Fifth calender	20/3	1400/83
Cooling roll	10/1	1400/216
Reel	7·5/0·75	1400/158

The section motor ratings, together with the gear ratios, are given in Table I. The second horsepower figure gives the rating at one-tenth full speed. On certain sections with journal bearings extra torque capacity had to be provided at the lower end of the speed range.

Each section motor is supplied from an individual generator, an arrangement which favours the use of a simple, shunt-wound, fixed-field motor, and leads to the possibility of smooth, controlled, independent starting and stopping of

Table II.—*Generator Grouping*

M.G. Set No. 1 :	
Second press generator	12·5/2·7kW
Second dryer generator	17/3·5kW
Couch generator	24/5kW
Driving motor	125 h.p.
First dryer generator	17/2·5kW
First press generator	12·5/2·7kW
Size vat generator	8·8/1·5kW
M.G. Set No. 2 :	
Smoothing roll generator	8·8/1·5kW
Spar cylinder generator	12·5/2·7kW
First calender generator	24/5kW
Driving motor	125 h.p.
Second calender generator	24/5kW
Third dryer generator	17/3·5kW
M.G. Set No. 3 :	
Fifth calender generator	17/3·5kW
Fourth calender generator	24/5kW
Driving motor	125 h.p.
Third calender generator	24/5kW
Fourth dryer generator	12·5/2·7kW
Cooling roll generator	8·8/1·5kW
Exciter Set :	
Alternator	18kW, 0·8 p.f., single-phase
Driving motor	46 h.p.
Exciter	9·5kW

individual sections with simple contactor control gear. A speed range of 10 : 1 presents no difficulty, because speed regulation is obtained by armature voltage control.

The generators are conveniently grouped in sets as shown in Table II. The second kilowatt

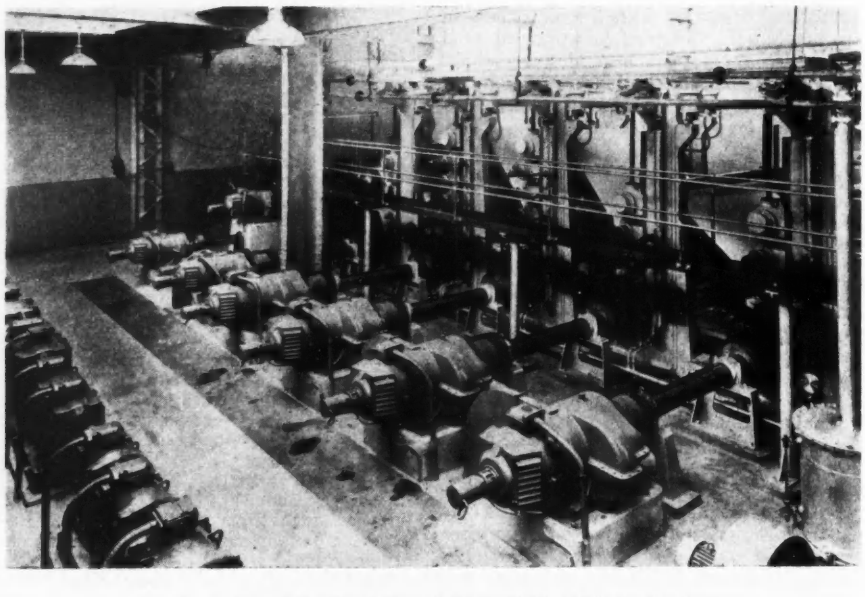


Fig. 4—Forced Ventilated Geared Motors Driving Calender Sections

figure gives the rating at one-tenth full voltage, selected to cover low speed and starting torque requirements.

Speed Regulator

A simplified schematic diagram of the speed regulator is reproduced in Fig. 6. The master speed control rheostat *PM*, which is motor operated and controlled by push buttons from the master control pedestal (Fig. 2) is connected in series with the crawl speed setting rheostat *PC* across the regulated 300V d.c. supply. The master reference voltage e_R is applied to the voltage reference circuit of each speed regulator, comprising the draw-adjusting rheostat *P*1 and section starting rheostat *P*3.

The latter is motor operated and its slider is normally at either of two extreme positions, at *y* when the section is stopped or running at "Crawl" speed, and at *x* when the section is running at papermaking speed.

The voltage e_1, which is the reference voltage of the section, and which can be varied with

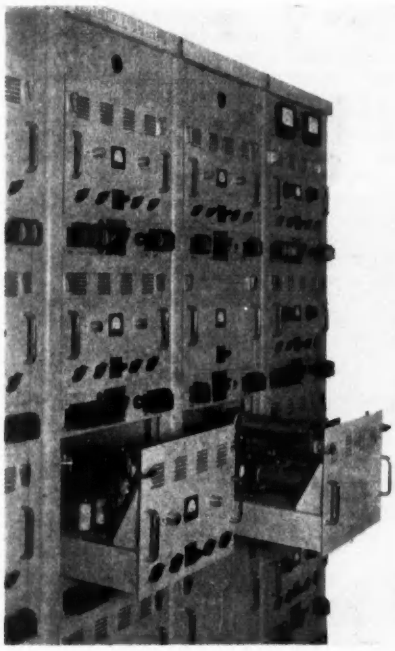


Fig. 5—Electronic Control Cubicle

respect to e_R by means of the draw control rheostat *P*1, is compared with e_2, the output voltage of the tachometer-generator *TG* coupled to the section motor *M*.

Neglecting for the moment the valve *V*9, which conducts only at "Crawl" speed, it will be clear that the voltage e_4, which is applied to the grid cathode circuit of valve *V*1, will change in response to variations of either e_1 or e_2.

The valves *V*1 and *V*2 with their associated components constitute a two-stage d.c. amplifier which controls a phase-shift network in the grid circuit of thyratrons *V*5–*V*8. These four thyratrons, in conjunction with the rectifier transformer *T*1, provide the excitation current for the field *F*1 of generator *G*. A negative bias field *F*2, supplied from the d.c. exciter, is provided to limit the range in current of field *F*1 required to effect a 100 per cent change in generator armature voltage.

The magnitude and polarity of the voltage e_7 determines the voltage applied by the thyratron rectifier to the generator field.

The provision of two thyratrons connected in parallel in each arm of the rectifier ensures continuity of service in the event of failure of one of them. These thyratrons are mounted at the front of the section tray, and their glow discharge is visible through a grille, so that a thyratron failure is readily detected.

Regulation of Section Speed

The operation of the speed regulating circuit may be followed (Fig. 6), assuming for the

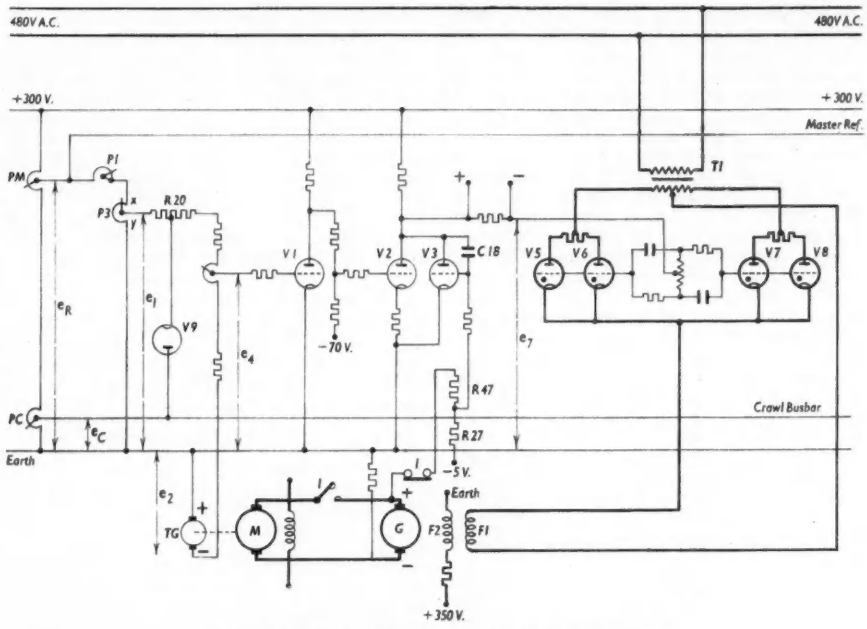


Fig. 6—Simplified Diagram of Electronic Control Panel

moment that the section motor *M* is running at a particular speed under the control of its speed regulator.

If the load on the section is reduced the motor speed and the voltage e_2 will tend to increase. This results in the grid voltage of valve *V*1 becoming more negative, with a corresponding reduction in anode current. The grid voltage of valve *V*2 becomes less negative and its anode current increases.

The resulting fall in anode voltage produces a fall in the voltage e_7, which causes a reduction in generator field current and hence in the voltage applied to the section motor, so that the actual rise in speed which takes place is very small.

As already mentioned, changes in speed due to load changes are kept negligible by providing an adequate degree of amplification. In the Guard Bridge installation the sensitivity is such that a 0·03 per cent change in speed produces a change in generated voltage of about 60V, which is slightly more than the total resistance drop in the armature circuit at full-load current.

Thus the change in speed which would result from a 100 per cent change in load is less than 0·03 per cent. In actual practice possible changes in load are considerably less than 100 per cent and variations in speed are therefore limited mainly to variations brought about by changes in the resistance value of components in the speed measuring circuit, and possible changes in the tachometer generator voltage at a given speed. These changes have been limited by careful design of the tachometer-generator and the speed-comparison circuit, so that the greatest possible variation in speed from all causes is less than 0·1 per cent. The tachometer generator is of special design; it has a permanent magnet field, a "Monel" metal commutator and two silver-graphite brushes per stud.

A high-sensitivity system such as that used to regulate section speed needs auxiliary circuits to prevent instability and to obtain a satisfactory response under transient conditions. The high-impedance electronic circuits permit the use of an easily adjustable condenser resistance network (not shown in Fig. 6), which functions as the electrical equivalent of a dashpot in a mechanical regulator to ensure an adequately damped response.

Referring again to Fig. 6, when the section motor is stationary the slider of the starting rheostat (*P*3) is at position *y* and the voltage e_1 is zero.

The valve *V*9 is connected with its anode to the slider of the "Crawl" speed rheostat *PC* and its cathode to the centre tap of resistor *R*20. When e_1 is greater than e_C the valve *V*9 is non-conducting, but when e_1 becomes less than e_C the anode of valve *V*9 becomes positive to its cathode and current flows. The voltage drop across the valve is small with the result that the centre tap of *R*20 is held at substantially the same potential as the slider of *PC*.

The voltage e_C is therefore the reference voltage with which the voltage e_2 is compared when either the section control switch is moved to "Crawl" or the "Inch" push button is operated.

With this form of drive no starting resistances are necessary in the armature circuit. It is essential to ensure, however, that the generator voltage is very low before closing the armature contactor (1). A voltage relay (not shown in Fig. 6), the coil of which is connected across this contactor, prevents closure of the latter unless this requirement is fulfilled.

The valve *V*3 in Fig. 6 is provided for regulating the generator voltage to a low value when the contactor 1 is open. The interlock 1 connects the positive terminal of the generator to the grid circuit of *V*3 and there the generator voltage is compared with a 5V reference source. Regulation is effected by valve *V*3 controlling the rectifier supplying field *F*1 of the generator.

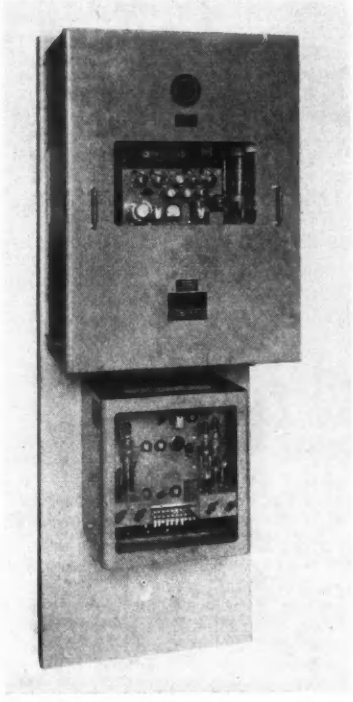


Fig. 7—Reel Electronic Control Panel

When contactor 1 is closed the generator armature is disconnected from the grid circuit of valve *V*3, the grid of which moves negatively at a rate determined by condenser *C*18. The voltage e_7 therefore rises until the speed reaches its "Crawl" value, when once again the speed regulator takes over control and raises the speed to the operating value, the valve *V*3 remaining non-conducting until the next starting operation.

All the electronic equipment is enclosed in six sheet steel cubicles, some of which can be seen in Fig. 5. Removable sliding trays accommodate the speed and voltage regulators and plugs and sockets are provided for the necessary connections between the trays and the cubicle wiring. There are spare trays for both speed and voltage regulators and they are kept energised to maintain the valve cathodes at working temperature so that, in the event of failure of any regulator, the shut-down delay would be limited to the time required to replace the faulty tray by the spare. Two trays are shown partly withdrawn in Fig. 5 ; one of these trays accommodates the master speed control rheostat.

The electronic control cubicles and the contactor boards (not shown in Fig. 5) are installed side by side in a control gear gallery, from which the photograph, Fig. 4, was taken.

Reel Control

The reel, being centre driven, requires a regulating system which is different from that of the other sections. As the reel builds up in diameter its speed must be progressively reduced and the torque applied to it by the motor must rise in proportion to the diameter in order to maintain constant tension in the paper.

These characteristics are readily obtained by the use of a d.c. shunt motor. The required change in speed with reel build-up is effected by shunt field control and the armature voltage is varied in proportion to paper speed so that constant tension is obtained by keeping the armature current constant.

The reel equipment comprises a six-phase, half-wave rectifier for supplying the armature

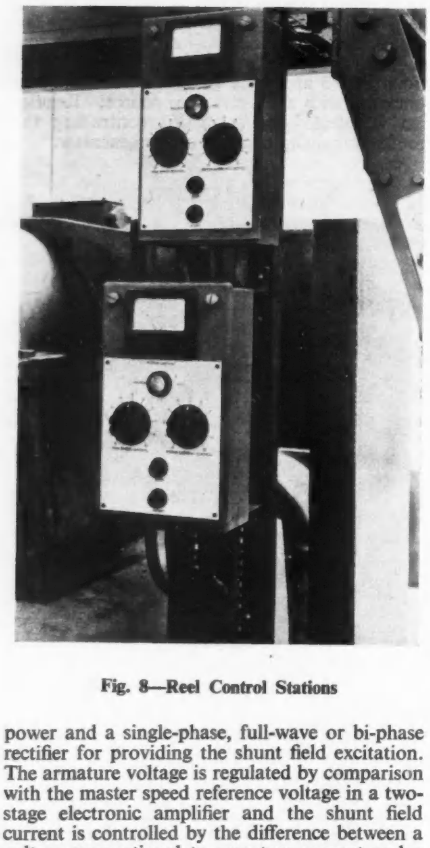


Fig. 8—Reel Control Stations

power and a single-phase, full-wave or bi-phase rectifier for providing the shunt field excitation. The armature voltage is regulated by comparison with the master speed reference voltage in a two-stage electronic amplifier and the shunt field current is controlled by the difference between a voltage proportional to armature current and a stabilised reference voltage.

Two identical reel equipments are provided for the double reel stand. The armature and field control units for one reel motor are shown in Fig. 7, the armature unit being the upper one.

The reel control stations are shown in Fig. 8. An ammeter is provided to give a measure of the tension in the paper. Apart from " Start " and " Stop " push buttons, the only other controls are two rheostat knobs, one to set the tension to be maintained in the sheet and the other to regulate the speed of the reel manually when matching the peripheral speed of the empty reel to that of the full one.

In the circuits described a derating factor of approximately 50 per cent is applied to all the valves ; thus a life in the region of 30,000 hours can be expected. Where possible, valves are paralleled, although this is not shown in the diagrams except in the case of the thyratrons.

The machine described in this article has been in service since December, 1952.

Gas Council's Annual Report

The fourth report of the Gas Council has just been published and it covers the twelve months' working up to March 31st last. The aggregate result of the twelve Area Boards' operations for the year on a gross income of just under £281,500,000 showed a net surplus of some £2,272,600. This surplus is after deductions of £14,430,600 for depreciation, £12,097,000 for interest, £2,538,000 for taxation, and £500,000 for contributions to the central guarantee fund. The only deficiency shown during the year was that by the Scottish Area Board; each of the other Boards made a profit. For the gross revenue of £281,500,000 some £164,000,000 came from gas sales ; £79,900,000 from disposal of by-products ; £23,400,000 from sales and hire purchase of appliances, and £14,200,000 from other sources.

As in the previous year a major problem with which the Council had to deal was created by the limited supplies of coal, steel and cast iron available. Estimates show that increases in the pithead prices of coal since the vesting date four years ago amounted to about 17s. 9d. a ton, and coal costs the gas industry at the current rate of consumption £25,000,000 a year more than it would have had to pay at that time. The decreasing availability of good gas-making coals has provided the industry with a great incentive, not only to seek means of improving the efficiency of existing processes, but also to look for new processes and new sources of supplies of gas. The report points out that a substantial increase in the efficiency of gas production has been obtained by adopting improved methods of working, the replacement of obsolete plant and the closing down of small uneconomic plants.

In the research programme which is being followed work has been continued on the effect of the modification in taper and other features of the design of continuous vertical retorts when carbonising different kinds of coal. In connection with the researches on complete gasification processes tests have been made on British coals in a Lurgi plant in Germany, pressure gasification, fluidised hydrogenation, and the gasification of powdered coal. In connection with the examination of new sources of the supply of gas which do not require the use of coal, plants for the production of butane/air mixtures have already been supplied, and in co-operation with the National Coal Board arrangements have been made for the experimental use of methane drained from mines. Pilot plants have also been installed for the gasification of oil, and consideration has been given to the supply and use of tail gases from large oil refineries. An extensive search is to be made over a period of five years to discover whether supplies of natural gas are available in this country in quantities sufficient to be of commercial value. During the year under review the sales of gas totalled 2523·7 million therms, an increase of 0·4 per cent over the previous year. Of this total, domestic consumers used 1366 million therms, industrial consumers 639·1 million therms, and commercial users 353·5 million therms.

The cost of gas manufactured and purchased was £164,300,000, of which £66,800,000 was recovered by the disposal of by-products. The cost of raw materials was £121,600,000, of which £109,200,000 was paid for the 27,590,000 tons of coal used in gas making. Of the 12,506,000 tons of coke and 2,784,000 tons of breeze produced, 10,325,000 tons of coke and 1,417,000 tons of breeze were sold. The sales of other products included 1,457,000 tons of tar, 81,100 tons of sulphate of ammonia, and 199,200 tons of spent oxide. Crude benzole recovery totalled 28,140,000 gallons.

Turbo-Electric Tanker "Helix"

Successful sea trials were completed last week by the turbo-electric oil tanker " Helix," which has been built by Swan, Hunter and Wigham Richardson, Ltd., for the Anglo-Saxon Petroleum Company, Ltd., and is the first of a general-purpose class of tankers to be completed. The main particulars of the ship are : length between perpendiculars, 530ft ; breadth moulded, 69ft 3in ; depth moulded, 39ft ; draught loaded, 29ft 8½in ; deadweight, 17,780 tons ; service speed, 14·5 knots, and turbo-electric main machinery of 7500 s.h.p. Model tests were carried out on the hull form at the N.P.L. experimental tank and the ship is fitted with a number of new devices designed to increase the safety of personnel and stores and to hasten the turn-round in port.

There is a special device designed to prevent dangerous gases from reaching parts of the ship where naked lights are used, and a cargo pumping system by which one pump room handles the same number of petroleum grades as was formerly handled by two pump rooms. A special painting technique has been adopted to combat external fouling and corrosion and there is a hygienic garbage chute which deposits ship's waste into the sea in an expendable container, while a pneumatically operated hoist removes tank bottom sediment. There is an overside lift, constructed by Clarke Chapman and Co., Ltd., for hoisting and lowering the ship's personnel and stores to and from the ship when lying at a quay. This link between ship and quay, which eliminates the hazards of climbing companion ladders set at varying angles, and is built of aluminium alloy, can carry six men or 10 cwt of stores without external guide rails and is stable irrespective of the ship's trim or list.

The painting system adopted involves the flame cleaning of the hull and the application of the full number of bituminous and oleo-resinous paints and anti-fouling before the vessel is launched so as to give complete protection from the instant the ship enters the water. Cargo heating coils of non-corrodible malleable cast iron, having fins to enlarge the heating surface, are fitted to obviate the need for the costly periodical renewal of this equipment item. To minimise the danger from free petroleum vapour, pressurisation has been adopted and the boiler-room is hermetically sealed and mechanically ventilated. Air entering the ventilation system is automatically tested for gas, and filters provide a margin of safety during which boiler fires and naked lights can be extinguished if the gas content of the incoming air reaches danger point.

Welding has been used for practically the whole of the ship's structure, which is built on the longitudinal system. For handling the cargo oil there are four turbine-driven pumps in one main pump room, the steam turbines being placed in the main engine room, and also two stripping pumps. The cargo oil pumps are of vertical centrifugal two-stage pattern manufactured by Drysdale and Co., Ltd., each having a discharge rate of 400 tons per hour. Steam-driven deck machinery is fitted and electric hydraulic steering gear, while fluorescent lighting has been adopted throughout.

British Thomson-Houston Co., Ltd., has supplied the main propelling machinery, which consists of a propeller motor having a maximum output of 8300 s.h.p. at 103 r.p.m., and a normal service output of 7500 s.h.p. at 100 r.p.m., with power supplied by two two-pole alternators driven by impulse turbines. Steam for the turbines is supplied by two Babcock and Wilcox integral furnace boilers fitted with superheaters, air heaters and automatic combustion control. The boilers are designed for a working pressure of 450 lb per square inch and a temperature of 750 deg. Fah., and operate under Howden's forced draught system.

Swedish Pneumatic Mining Equipment

We recently accepted an invitation from the Atlas Diesel Company to visit its works at Stockholm, in Sweden, and make a brief tour of some of the industries in which its pneumatic tools and compressors are used. A particular object of the visit was to see the production of equipment used for what is now generally known as the Swedish method of mining and tunnelling and some of the applications of the method.

FOR many years the Atlas Diesel Company, of Stockholm, Sweden, has specialised in the manufacture of pneumatic tools and equipment and air compressors, and it recently organised a Press tour to show the methods of manufacture and organisation at its works and some of the applications of its products. The company originated in the firm of Aktiebolaget Atlas, which was formed in 1873 for the purpose of making, purchasing and selling all kinds of materials used in the running of railways. A works was opened at Södertälje, south of Stockholm, and, in co-operation with the British firm of Beyer, Peacock and Co., Ltd., the new company began to manufacture railway carriages, boilers and steam engines for the Swedish railways. Within a few years the increasing activities of the company made it necessary to open a new works in Sickla, Stockholm, and its range of products thereafter steadily widened to include heavy forgings, castings, locomotives, machine tools, bridges, &c.

Probably the firm's first serious interest in pneumatic tools started as far back as 1888, when a large pneumatic squeeze riveter was purchased for use in its boiler shops. Within a very short while it began to make several kinds of pneumatic tools for use in its own shops. Following a brief period of manufacturing an air compressor of German design the firm decided to develop one of its own, and in 1905 it started to manufacture compressors rated at 570 cubic feet per minute.

The manufacture of diesel engines, the second of the two principal products of the firm for many years, was begun in 1898, when the first engine was made for A.B. Diesels Motorer. These two companies derived their capital from the same source and in 1917 a new company, A.B. Atlas Diesel, was formed for the production of compressed air equipment and diesel engines. In 1948 the diesel engine interests were disposed of and since that time the whole of the productive capacity of the firm's five works in Sweden has been devoted to the manufacture of compressed air tools and equipment and air compressors.

The first visit of the recent tour was made to the principal works of the firm at Sickla. This works is mainly concerned with the manufacture of stationary and portable air compressors of many types and sizes, and all kinds of percussive pneumatic tools, of which rock drills are the most important. All the rotary pneumatic tools manufactured by the firm are now being made at a separate factory in Stockholm. This class of production was transferred from the main works recently in order to provide facilities to increase the rock drill output.

At the Sickla factory there are two main production buildings, one of which is a four-storey structure used for the manufacture of pneumatic tools. The other is a single-storey building, which was originally used for diesel engine manufacture and is now concerned solely with the manufacture of air compressors. In addition to these main production shops, the 50-acre works site includes a large office block, a service building, a forge, a heat-treatment shop, a generating station, laboratories, painting and finishing shops, &c.

Large Compressor Erection Bay

Most of the ground floor of the building engaged in pneumatic tool production is equipped with automatics, turret lathes and other machines used for producing the larger parts from bar stock, castings and forgings. The smaller parts for the rock drills are manufactured on the first floor of the building, whilst the second floor is equipped with plant for the production of components for other percussion tools, such as hammers, riveters, &c. On the top floor is a tool grinding section, in which all the cutting tools used in the machine shops are sharpened and serviced.

In the production shops components are manufactured in batches, the size of which can vary considerably from time to time, and for this reason the machines are arranged generally in groups to perform the complete sequence of operations on a particular component. Within these groups special single-purpose machines have their tooling so arranged that a range of different sizes of a single component can be handled with a minimum loss of time for re-tooling or resetting between batches. The tools, jigs and fixtures used incorporate up to date practice to give high production rates with a consistent degree of accuracy, and full use is made of high-speed machining techniques and multi-station and rotating fixtures and pneumatic and hydraulic clamping. From the machine shops all parts, after final inspection, are delivered directly to a central stores. In these stores components are batched for issue to the assembly lines as required, or sent to the packing department for despatch to spares stockholders in many parts of the world.

It will be appreciated that a high-speed pneumatic tool has certain parts which have a much higher wear factor than others, and for this reason a proportionately larger stock of such parts has to be maintained for servicing purposes. In order to facilitate the quick replacement of such parts by users of the tools and ensure that the efficiency of a tool is retained when replacements are fitted, a very close system of manufacturing tolerances has to be observed at all times both within the production batches themselves and between successive batches.

The tools are assembled in a shop adjoining the central stores and after each tool is built it undergoes a short running-in period. It is then transferred to a test section equipped with special rigs, where the performance, air consumption, &c., is checked before the tool is sent to the finishing and packing department.

In the air compressor section of the factory the component parts are made in a well-equipped modern machine shop which adjoins a heavy erection bay, part of which can be seen in the illustration on this page. In this bay the heavier machines are moved across the floor as erection proceeds until, by the final stages of construction, they are in position on the test beds against the far wall. The smaller stationary machines are assembled in groups at one end of this section, and the portable compressors in another part of the shop. When their tests have been completed the compressors are transferred to a large finishing shop adjoining the packing department, where they are painted and fitted in accordance with customers' special requirements.

A particularly interesting part of the works is a small mine shaft, which has been sunk into the underlying granite and is used for trying out new tools and equipment. This shaft provides a valuable testing ground in close proximity to the workshops and design departments of the development and research sections of the organisation. One of the photographs we reproduce shows a drill being tested in this mine.

The Atlas Company was largely responsible, with the co-operation of the Sandvik Steel Works Company, for the development of what is known as the "Swedish" method of mining and tunnelling and is now generally familiar to all mining and civil engineers. In this method lightweight pneumatic rock drilling machines are used in conjunction with pneumatic pushers and operate with tungsten carbide tipped drills. The light weight of the drill imparts no fatigue to the tungsten carbide bit, and a complete drilling unit can be quickly and easily moved between drilling operations. The durability of the bit gives a consistently high drilling rate, and deep holes of a given bottom diameter can often be completed with one steel. For this particular method a range of lightweight drilling machines has been developed to suit different conditions, and a number of types and sizes of Sandvik "Coromant" tungsten carbide tipped drill steels have been introduced. In these steels the bit is brazed directly into the rod and the stock is made as a chisel bit shaped to give a high drilling speed without binding. The drill rod is hollow and the blowhole is placed on one side of the bit stock. It is of interest to note that a recent addition to this range of tools is a new flexible drill for deep hole drilling purposes. This flexible drill is designed for use under certain confined conditions where extension rods cannot conveniently be used. It has a tungsten carbide bit and is rectangular in cross section and, like the standard steels, has a hole throughout its length for blowing purposes.

Following the visit to the Atlas works a short

visit was made to the works of the Sandvik Steel Works Company at Sandviken, where, in addition to rock drill steels the firm makes large quantities of cold-rolled strip steel, pipes, tubes, saws and a wide range of other high-quality steel products. Of particular interest at this works is a large new plant which has been laid down for the production of sponge iron by the Wiberg process, and for which the raw material is largely supplied by the company's own mine at Bodäs.

The Bodäs mine is used, in addition to the production of ore, as an experimental station for the testing of "Coromant" drill steels. Tests are made on two levels in this mine and are of two kinds: drilling in granite and leptite, according to laboratory practice, for research purposes; and secondly, a continuous quality check of production steels under actual mining conditions in drilling iron ore. Some 75 miles of test holes were drilled in this mine last year.

In a visit to the Grangesberg mine, one of the most important in the country, we saw the Swedish method in full operation. Here teams of three men working on two separate faces were stated to be producing some 100 tons per shift. Whilst the driller of the team works on one face the two other men, using a pneumatic power loader and skips, clear the other face. The driller, after completing his pattern of holes, charges and fires them, and then moves with his equipment to the face cleared by the loaders. Operations are timed so that all shots are fired just before the shifts break, so that when the men return drilling and loading can proceed without delay. The speed with which the light-weight drilling equipment can be moved from one working point to another and put into operation without delay was particularly noticeable in both of the iron mines we visited.

At Gävunda, on the River Van, the Stora Kopparberg Bergslags Company is building a new power plant and we were shown work in progress in the tail-race tunnel. Here six drills are used on a two-deck carriage for driving the 7m by 6½m tunnel through hard granite. In each pattern sixty-seven holes are driven 3m deep and the rate of advance made with the tunnel averages 3·3m each two-shift day.

At the end of this visit to Sweden a short time was spent in the shipyards of A.B. Götaverken and Eriksbergs Mek. Verkstads A.B. in Gothenburg, where Atlas pneumatic tools and air compressors are extensively used.

A WASTE OIL FIRING UNIT.—A portable waste oil firing unit made by Kamel Products, Ltd., 21, Leigh Street, Liverpool, is suitable for use with central heating boilers of between 100,000 and 350,000 B.Th.U. capacity. The unit, which is designed to operate on waste or any ordinary fuel oil, is so constructed that no alterations are needed to fit it to existing boiler installations. It consists of a small enclosed reservoir incorporating all the necessary valves, cocks, gauges, a preheater air coil, an electric immersion heater, a high pressure jet blasting cock and a spray cock with a detachable head.

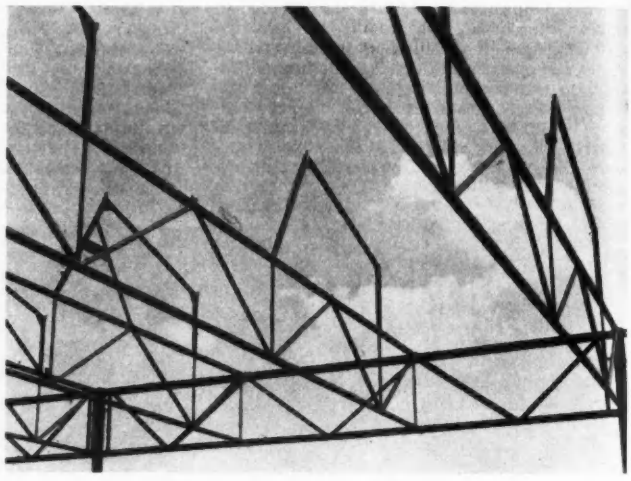
Welded Tubular Steel Factory Structure

The structural frame of a factory recently erected at Hemel Hempstead consists of a completely welded assembly of tubular steel columns and trusses. For the particular structural requirements of this building, considerable economy was achieved by the use of this method of construction.

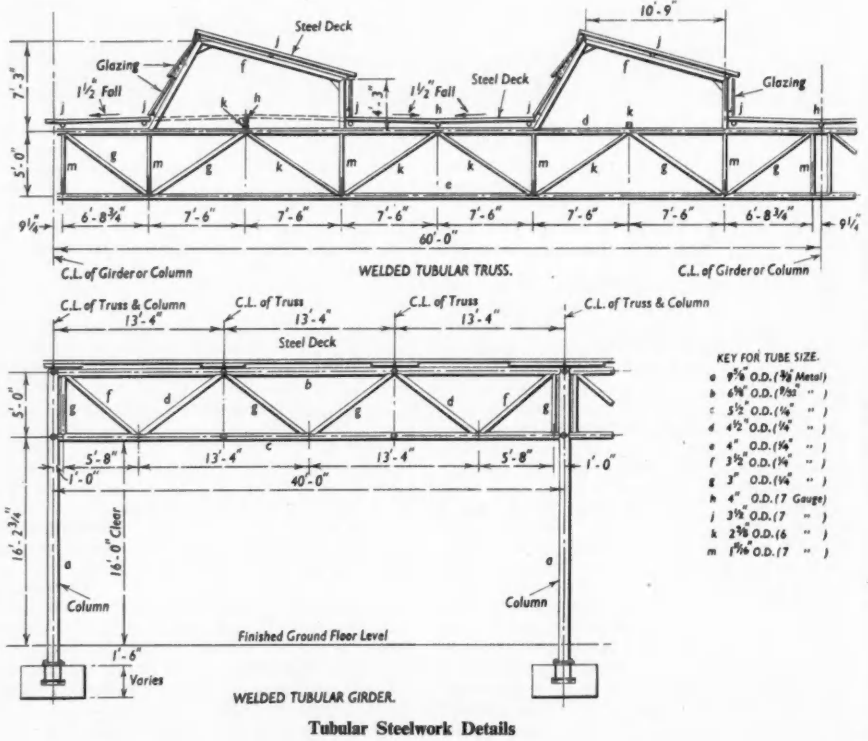
THE use of steel tubes in structural engineering may sometimes result in appreciable economies. The advocates of this form of construction have aroused no little interest by their various achievements of the past few years, which seem to indicate that good progress is being made. A recent example of the use of tubular steel in structural work is the new factory built for Rotax Ltd., at Hemel Hempstead, in Hertfordshire. This factory is said to be the first in Great Britain to have an all-welded tubular steel frame.

The building was planned, to suit the various requirements of production, on a module of 60ft by 40ft. It was also stipulated that there should be an even intensity of natural light at the working plane, and so a monitor roof was chosen, admitting principally north light, but some south light as well. The arrangement of glazing adopted gave an average skylight factor of 11·5 at a height of 2ft 9in above floor level. The main production shop is 460ft wide (seven 60ft spans and one of 40ft) and 360ft long (nine 40ft spans), giving an area of about 165,000 square feet. The two cross-sectional drawings of the factory show how these requirements have

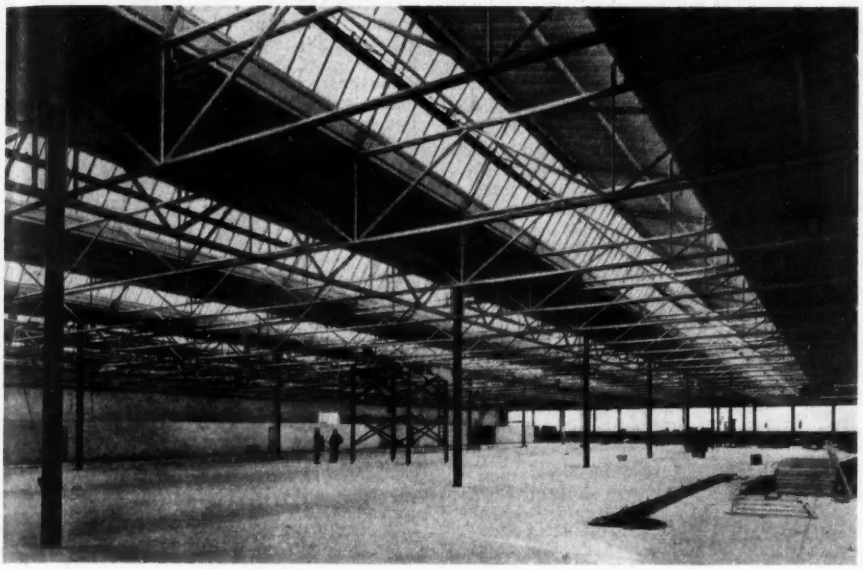
Rock Drill Undergoing Test in Mine



Monitor Frames Erected on 60ft Trusses



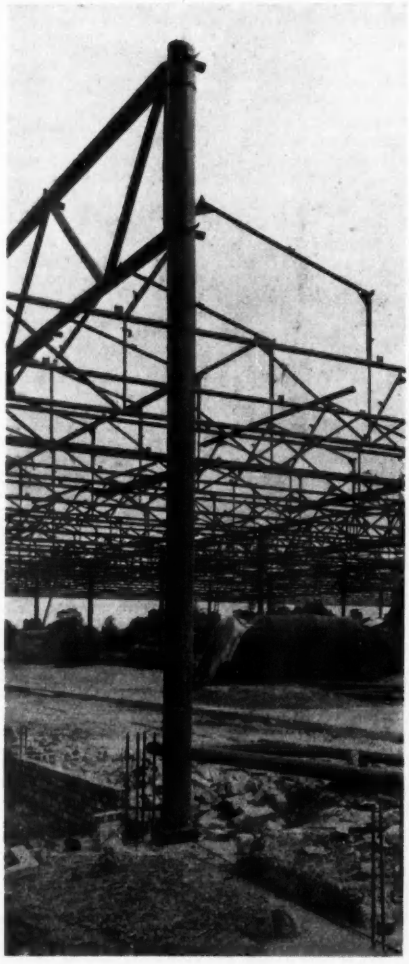
Tubular Steelwork Details



Completed Tubular Steel Factory Structure

governed the structural form. The 60ft span trusses which carry the monitors are spaced at 13ft 4in centres, the two intermediate lines of trusses between the columns being carried by the 40ft span lattice girders.

Various phases in the erection of the steelwork are shown in the photographs reproduced with this article. The 60ft trusses were delivered to the site already fabricated, with the exception of the monitor frames, each monitor frame being welded on to the truss *in situ*. The 40ft girders were also delivered to the site complete, so that the principal site welds were at the junctions of the columns and roof steelwork and where the 60ft trusses were carried on the 40ft girders. The configuration adopted for the roof framework with horizontal top and bottom chords was particularly advantageous for erection; "cup"-shaped bearing pieces were welded on to the columns at the erector's works, and when the columns were erected it was only necessary to place each girder or truss with the end of the tube forming its top or bottom chord resting in the appropriate "cup" bearing. With four such bearings the truss or girder in question was held safely in position, without any need for temporary stays, bolts or bracing, until the joints were welded. A second semi-circular "cup" was added over the top of the tube when the welding was carried out. The cup-shaped bearing pieces are clearly shown in one of the illustrations herewith; they were also added to the girders at the points where the 60ft trusses rested.



"Cup" Bearings on Typical Column

The columns were secured at their bases by holding-down bolts, in the usual manner, but no other bolts were used throughout the structure. The columns weighed about 1000 lb each, the 40ft girders weighed 1810 lb each, and the 60ft trusses 1775 lb each. The monitor frames weighed only about 2 cwts each. Thus erection could be simply carried out with the aid of a mobile crane, the heaviest lift being less than a ton. A gang consisting of a ganger, four welders, two erectors, two scaffolders and five labourers carried out the work. The total weight of steelwork was 450 tons and the scheduled rate of erection was one bay a fortnight, about sixteen weeks altogether. Tubular steel purlins were used for the roof, with the exception of the glazing purlins, which were angles. The purlins were carried on purlin plates welded to the top chords of the trusses as may be seen in one of the illustrations; they were formed from random lengths of tube welded at the joints. The roof was covered with sheet steel and "Ruberoid." There are no expansion joints in the steel frame, as the brick perimeter walls were built in panels between reinforced concrete columns which were considered to be flexible enough to take up thermal movements.

The 60ft roof trusses were each designed to carry four ½-ton point loads at the panel points, to allow for services and other suspended loads, and the building was designed in conformity with the code of practice for tubular steel construction CP113 : 201. One of the main ideas behind the design was to economise in the quantity of steel required, and in fact, a weight of about 6 lb per square foot of the factory area was used, which would compare with about 9 lb per square foot for a conventional steel design. Apart from an estimated saving of some 33 per cent in the weight of steel, it was also considered that the total cost of this particular tubular structure was some 10 per cent less than the total cost of conventional steelwork. As regards comparison with a welded design in conventional steel-work, it was estimated that the tubular design showed a saving of some 20 per cent in weight alone.

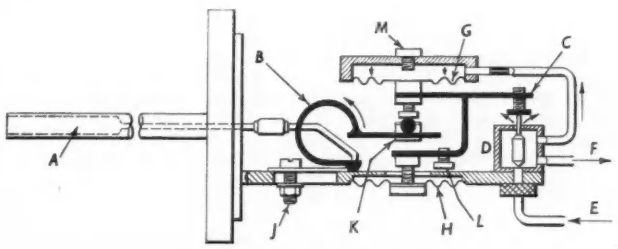
The consulting engineer responsible to Rotax, Ltd., for the structural design described above was Mr. T. Bedford; the architects were Messrs. Clifford Tee and Gale. The main contractor was J. Jarvis and Sons, Ltd., but the welded steel frame was fabricated and erected by Tubewrights, Ltd.

Air-Operated Temperature Transmitter

PARTICULARS of a new air-operated transmitter for use with distant recording, indicating and temperature control instruments, have been received from Negretti and Zambra, Ltd., 122, Regent Street, London, W.1. This temperature transmitter incorporates a mercury-in-steel system and employs the force balance principle. It is suitable for use with temperatures up to 1200 deg. Fah. and requires an operating supply of compressed air at 20 lb per square inch, the air consumption being some ⅛ cubic foot of air per minute.

The arrangement of the new unit and its principle of operation can be followed by reference to the diagram we reproduce.

The bulb of the mercury-filled system is indicated at *A* and it will be appreciated that an increase of temperature at the bulb causes the bourdon tube *B* to move in the direction of the arrow. Through the right-hand projection of the tube the movement serves to lift a valve-operating frame *C*, together with an air leak valve *D*. The main air supply from the tube *E* then flows



Mechanism of Temperature Transmitter

freely into the transmission system via the tube *F*, to the receiving instrument—an indicator, recorder or controller. The air is prevented from escaping past the top of valve *D* to the atmosphere when it is in this position. The diaphragm *G* is also connected to the chamber of the air leak valve, and the rise of pressure in the transmission system actuates this force balance diaphragm to return the bourdon and reset the valve *D*. This action maintains a balance of force between the bourdon tube and the diaphragm and, at the same time, allows a transmission of pressure to the receiving instrument.

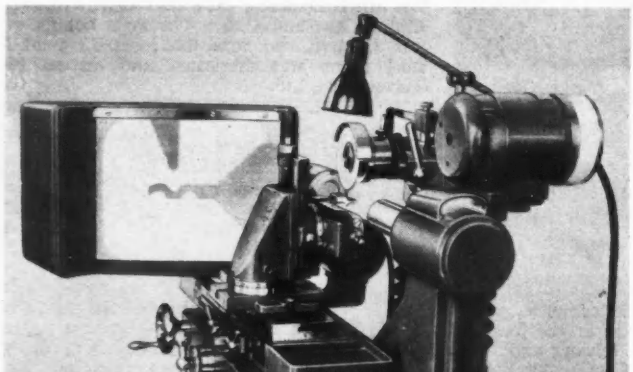
The upwards force of the bourdon tube is proportional to the bulb temperature, whilst the downwards force of the diaphragm is proportional to pressure. It follows, therefore, that the pressure in the transmission system is directly proportional to the temperature being measured.

The system is supported on the instrument by a diaphragm *H*, and a coarse range adjustment *J* and fine range adjustment means *K* are fitted. A pressure overload stop *L* is fitted on the valve-operating frame and a temperature overload stop *M* is above the diaphragm. The means of ambient temperature compensation for the instrument is arranged in the capillary tubing in front of the bourdon tube.

Profile Grinding Attachment

AN optical profile grinding attachment has been introduced by the Svenska Ackumulator Aktiebolaget Jungner, of Stockholm, 14, Sweden, for use on its universal tool grinding machines. This attachment is quick and easy to fit and is used in conjunction with a transparent paper on which the desired profile is drawn ten times as large as the required finished work size. The drawing is fixed to a projection screen on the left-hand side of the machine, as shown in the accompanying illustration.

The workpiece to be ground is held in a vice carried on slides in an angle fixture mounted on the table of the machine. A lamp on the right-hand side of the table projects a beam of light into a magnifying unit at the opposite end of the machine. The workpiece is adjusted in the vice so that it comes between the light source and the magnifying unit which projects its enlarged image on the screen. The profile of the grinding wheel is also projected on the screen and the formation of the contours on the workpiece to comply with those of the drawing is effected by operation of the machine's vertical and cross traverse handwheels. During the grinding operation the table is automatically reciprocated longitudinally at about 115 strokes a minute by the feed motor.



Profile Grinding Attachment

A wheel forming device can be used in conjunction with the profiling attachment, and with this device a wide range of radii and angles can be formed on the wheel.

Immersible Tractor

AN immersible tractor has recently been designed and produced by John Fowler and Co. (Leeds), Ltd., to satisfy the requirements of the Royal National Lifeboat Institution. Our illustration shows a watertight version of the company's " Challenger 3 " diesel crawler tractor, which is powered by a 95 b.h.p. Meadows engine. The tractor has to haul a lifeboat and carriage, weighing nearly 20 tons, over beaches involving steep gradients and consisting of wet and dry sand, mud and shingle. For pulls exceeding the 21,000 lb limit of the drawbar the tractor is equipped with a Fowler winch which has a maximum pull of 38,500 lb, while adequate protection is provided to withstand severe beach conditions and to resist salt water corrosion.

Sometimes the haul to the water may be long at low tide and at the water's edge the carriage is reversed into the water and the tractor detached so that it is free to push the carriage into deeper water by means of a front buffer plate. For the purpose of launching the boat two ropes are attached to the stern and lead forward on either side, in a seaward direction, and then carried over pulleys, on the carriage, back to the front " towing eyes " of the tractor. The tractor is then put into reverse and the pull on the ropes has the effect of pulling the lifeboat from the carriage towards the sea to complete the launching. On its return the tractor winch hauls the boat up the beach on skids and so back on to the carriage.

One important requirement is the ability to operate continuously at full power when submerged to a depth of several feet. To meet this the engine is completely encased and the tractor made watertight, but for maintenance purposes provision has been made to give access to the engine through panels in the engine casing. However, although lifeboat crews have intimate knowledge of their beaches, shifting sands may cause the tractor to be bogged down and recovery made impossible until low tide, during which time the tractor may be submerged. To overcome this contingency the air intake and exhaust ports are fitted with valves which can be clamped down quickly by means of a handwheel in the driver's compartment, while, at the same time, the engine automatically stops.

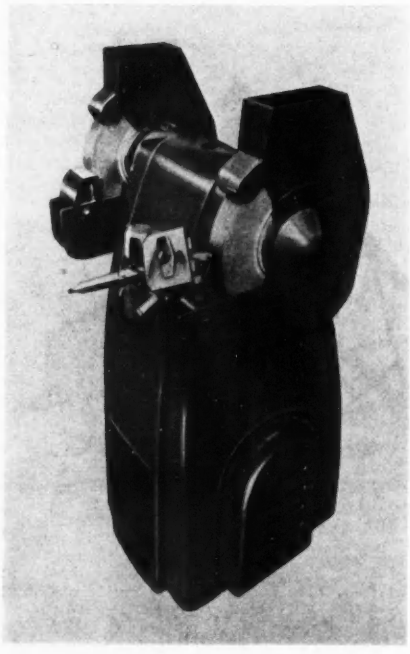
Steering is effected by a vertical hand wheel, on a marine style steering pedestal, which operates the interconnected steering clutches and brakes. A partial turn of the wheel to right or left declutches the drive to either side to make a turn, while a further turn of the wheel progressively applies the brakes to reduce the diameter of the turning circle. Fuel control levers are mounted on either side of the steering pedestal and a hand brake is provided for emergency stops and parking.

" Challenger 3 " Immersible Tractor

Twist Drill Grinding Machine

PARTICULARS have been received from B. Elliott and Co., Ltd., of Victoria Works, Willesden, London, N.W.10, of a twist drill grinding machine suitable for drills from ¼in to 1in diameter which it is now making. As can be seen from the photograph we reproduce the machine is of pedestal design, with two grinding wheels, one of which is suitable for normal tool grinding purposes, the other being fitted with a tool rest equipped with a fixture for drill grinding.

The machine is driven by a 2 h.p. motor and its spindle, carrying 12in diameter by 1¼in wheels, runs at 1787 r.p.m. A drill to be ground is clamped in the fixture between self-centring vee blocks. A fulcrum pin projects from each of the two sides of the fixture, and the fixture is supported on a pillar by each of these pins in turn to grind the two lips. During the grinding operation the loaded fixture is swung about each of the fulcrum pins and the amount by which the drill is fed into the wheel is controlled by a stop. By working up to this stop the angles formed by the finish ground lips are made concentric with the centre line of the drill.



Twist Drill Grinding Machine

When setting the drill in the fixture the operator locates it with one lip bearing against a fixed steady blade, whilst he tightens up the vee blocks. About 0·030in of the drill is allowed to protrude beyond the steady blade, and as the drill is not moved in the fixture to repeat the setting for the other lip, the amount of material removed from each lip is exactly the same.

Industrial and Labour Notes

The Coal Situation

On Monday last, the House of Commons debated the fuel and power industries. The debate was opened by Mr. Geoffrey Lloyd, the Minister of Fuel and Power, who gave some up-to-date figures concerning the coal situation. He said that in the first few months of the year production in the coal mines was disappointing. For that reason, the joint campaign between the National Coal Board and the miners' leaders had been undertaken, and thereafter there had been a very considerable improvement in the rate of production as compared with last year. The position at present, the Minister continued, was that out of 5,500,000 tons loss of output through additional holidays, 3,500,000 tons had already been made up. That was a very considerable achievement, but the fact must be faced that there was still a gap of 2,000,000 tons which had to be made up. There were, however, still the two months to go which were normally the biggest producing months in the year in the mining industry.

Coal stocks, the Minister went on to say, had recently been rising exceptionally fast, a situation which had been helped by the weather and also by the import plans announced earlier in the year. The latest stock figure, on October 17th, was just under 18,400,000 tons. There were then two weeks to go before the beginning of the coal winter, and on the average stocks had risen by between 300,000 and 350,000 tons a week in recent weeks. There was, therefore, a good prospect of arriving at either just under or just over 19,000,000 tons by the beginning of the coal winter. That, Mr. Lloyd said, was—apart from last year—more than 2,000,000 tons higher than the country had had as stock with which to face the winter in any post-war year.

Later in his speech, the Minister referred to organisational changes which the National Coal Board had proposed. The first was that the colliery manager should have the maximum responsibility in the day-to-day management of his pit, and the second was that the area was really the proper unit of higher management in the industry. The Coal Board had issued instructions making it clear throughout the whole organisation that the area was regarded as the vital unit of higher management, and that the area general manager was in effective charge of his area, subject, of course, to necessary co-ordination and full accountability to the divisional board. Furthermore, the Coal Board intended to carry out an examination of its whole organisation and, in particular, to make sure that its organisation was well adapted in the light of the instructions which it had given.

Oil Distribution Workers' Strike

The unofficial strike of tanker drivers and others engaged in the distribution of petrol and oil in the London area ended on Tuesday. It began in the early part of last week, and by the end of the week—when road transport and other essential services in the Metropolitan area seemed likely to be seriously curtailed—it was reported that between 2500 and 3000 men had ceased work.

It appears that the strikers objected to the employment of non-union men, and to the oil companies passing over parts of their distribution work to contractors. The employees of these contractors, it was argued by the strikers, must belong to a union. A final demand was that the oil companies should grant a wage increase of 10s. a week. The men involved in the strike belong to the Transport and General Workers' Union, the officials of which refused to support the action taken and appealed straight away for an immediate resumption of work.

Statements made in Parliament towards the end of last week gave details of the steps taken by the Government to mitigate the difficulties caused by the strike, and last Friday the Minister of Labour, Sir Walter Monckton, announced that arrangements had been made for the distribution of petrol and other fuel oil to be undertaken in the London area by members of the Forces. This announcement was welcomed, on behalf of the Opposition, by Mr. Robens, and the operation proceeded smoothly throughout the week-end. On Monday, at meetings held by the strikers, the majority was in favour of a return to work, and it was stated that the Transport and General Workers' Union would at once begin negotiations with the employers on some of the matters over which the dispute had arisen.

Conditions in the Drop Forging Industry

In June, 1951, H.M. Chief Inspector of Factories appointed a committee to consider working conditions in the drop forging industry. The terms of reference covered the safety, health and welfare of persons employed in the industry, and the committee was also directed to draw up an agreement specifying the minimum standards for compliance with the requirements of the Factories Acts of 1937 and 1948.

The committee has now published its report (H.M. Stationery Office, 1s. 6d.). It recommends that new forge buildings and the layout of the plant they are to house should be given careful consideration at the planning stage to ensure that the factory, when established, can be run on modern lines with good working conditions. The committee also thinks that much can be done in existing forges to improve working conditions and safety, and the report says that a properly and systematically planned campaign to improve conditions must result in the betterment of industry as a whole. The report goes on to urge that employers and employees should have a clear understanding of the hazards inherent in the industry and of the means to overcome them, and also of the standards of safety to be maintained so far as the plant in use is concerned. Some specific suggestions on this matter are included in the report. Another recommendation is that welfare facilities in the drop forging industry, such as bathing and washing, cloak-room and canteen accommodation, should be reviewed with a view to a general improvement. Finally, the recommendation is made that trade practices and prejudices, which in the past have retarded the progress of the industry, should be overcome by a mutual appreciation of the difficulties both on the part of employers and employed and a willingness to overcome them by co-operation and common sense.

The committee has expressed the hope that the drop forging industry will look carefully into the recommendations made in the report and that improvement schemes will be prepared for every forge. It feels that if its recommendations are fully implemented, they will go far to eradicate the unsatisfactory aspects which have for so long been characteristic of the industry. The committee also considers that consultation in the industry between employers and workers and H.M. Inspectors of Factories should continue in some form, and the suggestion is made that a standing joint committee for the drop forging industry should be established.

Overseas Trade

Final figures about the United Kingdom's overseas trade in September were issued by the Board of Trade at the end of last week. They show that the value of exports in September was £202,200,000, and that the monthly average value of exports in the third quarter of this year was £211,600,000, which was a little above the average for the second quarter. Imports in September were valued at £269,400,000, making the monthly average in the third quarter £274,800,000, which was nearly 6 per cent below the average for the second quarter. The average monthly value of re-exports in the third quarter was £8,500,000, the excess of imports over total exports in the quarter averaging £54,800,000 a month, compared with £73,700,000 in the preceding quarter. The Board of Trade says that, so far this year, the trade deficit has averaged £60,800,000 a month, compared with £63,000,000 a month last year. The deficit with the non-sterling area has averaged £36,500,000 a month, compared with £50,200,000 last year.

In a statement which accompanies the figures, the Board of Trade says that the value of exports has shown a slight increase in each of the last two quarters, although it remains £1,500,000 below the monthly rate achieved in the last quarter of 1952, when there was some recovery from the low level of the summer of that year. The volume of exports has been rising slowly since the first quarter of this year and in the first nine months has been slightly higher than in the comparable period of 1952. Exports of engineering products in the third quarter of this year were valued at £81,000,000 a month, compared with £86,000,000 in the second quarter and £83,000,000 in the first. The only commodity group to show a very slight increase over the second quarter was cutlery and hardware ; in the remainder the decline was general, affecting nearly all the principal items. The largest drop, averaging nearly £3,000,000 a month, was in exports of machinery. In fact, the total value of machinery exports in the third quarter was lower than for any quarter in the two preceding years.

The Export of Coal

Speaking at the annual general meeting of Powell Duffryn, Ltd., which was held on October 21st, Sir Herbert Merrett, the chairman, said that " two-way traffic " was not new to the coal producing and importing countries of the world. It would, therefore, be unfair to criticise unduly what was now happening, namely, the import of coal into this country and its export to other countries. During the period of adequate supply before the war, coal users abroad were becoming increasingly selective in their demands, but during and since the war shortage of supply to demand permitted producers to sell, to a very large extent, whatever supplies they had to spare, regardless of quality.

Things had now changed considerably, Sir Herbert continued, and we were back to a buyer's market. This country, therefore, was compelled to live up to specifications which were somewhat exacting. It was fortunate, however, that if developments were quickly centred upon those valuable reserves of saleable coal for export, we should still be able to hold many of the markets where high prices could be obtained, even though it might be necessary to import domestic and industrial qualities which were in plentiful supply in Europe, without having to expend dollars for American coal.

Sir Herbert went on to say that the Coal Board had an enormous task in hand, but its progress was too slow and expenditure upon modernisation was behind time. It was also to be hoped that the appeals which were being made for greater effort and increased output per man employed would be more fully appreciated, without further delay, by those who had in their hands the well-being of the greatest of our national industries and, to a large extent, the control of the country's trade balance.

Iron and Steel Production Capacity

The Iron and Steel Board, following consultation with the industry, has circulated to iron and steel producers a notice concerning proposals for modernisation or development. This notice is given under the powers conferred on the Board by Section 6 of the Iron and Steel Act, 1953, and requires that proposals for modernisation schemes estimated to cost more than £100,000 shall be submitted for the Board's consent. Particulars of the proposals are to be given in writing, and the works concerned cannot be proceeded with until the Board's written permission has been received. The notice does not apply to proposals to provide additional production facilities consisting only of premises, plant or machinery which it is intended to use for the activities mentioned in Section 6 (6) of the Iron and Steel Act, 1953, nor to the provision of additional production facilities under Section 5 (3) of the Act.

Notes and Memoranda

Road and Rail

MINISTRY OF TRANSPORT AND CIVIL AVIATION.—The amalgamation of the Ministries of Transport and Civil Aviation became effective on October 22nd, and the addresses of certain headquarters departments of the former Ministries have been changed. The main headquarters of the Ministry of Transport and Civil Aviation are at Berkeley Square House, London, W.1 (Mayfair 9494). The Controller of Civil Aviation Ground Services will, for the time being, remain at Ariel House, London, W.C.1 (Chancery 3366), and the highways administrative and engineering staffs are at 21/37, Hereford Road, London, W.2 (Bayswater 3456).

MR. H. CLUTTERBUCK.—We have learned with regret of the death, on October 19th, of Mr. Harold Clutterbuck, M.I.Mech.E., the technical manager of the Society of Motor Manufacturers and Traders. After being apprenticed to Alfred Herbert, Ltd., Mr. Clutterbuck joined the S.M.M.T. in 1923 and became draughtsman in the standardisation department under Mr. T. H. Woollen. In course of time he became manager of the technical department and was responsible for liaison with the Ministry of Transport and other Government departments on all technical matters concerning lighting and construction and use regulations. In addition, he had many associations with the steel and drop forging industries, and also represented the Society on numerous occasions on international committees.

Air and Water

MAIDEN VOYAGE.—The Peninsular and Oriental Steam Navigation Company expects that the 28,000-ton liner "Arcadia," which was launched in May from the yard of John Brown and Co., Ltd., will leave on her maiden voyage on February 22, 1954, calling at Port Said, Aden, Bombay, Colombo, Fremantle, and Melbourne on the voyage to Sydney.

MARITIME CONSULTATIVE ORGANISATION.—We are informed that the British Government, which ratified the convention for the establishment of the Intergovernmental Maritime Consultative Organisation (I.M.C.O.) in 1949, invited the other thirteen governments, which have adhered to the Convention, to a meeting which began on October 27th. The purpose of the meeting was to consider measures to bring I.M.C.O. into being, since the adherence of seven more governments are required to bring the Convention into force.

A CANADIAN AIRCRAFT ACCESSORY PLANT.—On Tuesday, October 13th, the new factory, known as the North Plant, was officially opened for Dowty Equipment, Ltd., at Ajax, Ontario, by Air Vice Marshal D. M. Smith. During the war period the company was responsible for the manufacture of a large amount of aircraft equipment in Canada at Montreal. When it soon became apparent that the company's main customers were in the Toronto area, the plant was moved from Montreal to Ajax, 20 miles east of Toronto. In Canada, the company makes wheels, brakes and brake-operating gear for the Dunlop organisation.

Miscellanea

LLANDARCY REFINERY.—A special plant being installed at the Llandarcy Refinery of the Anglo-Iranian Oil Company, Ltd., will shortly begin the production of micro-crystalline waxes, which are normally imported from the U.S.A.

CATALYTIC CRACKING PLANT.—The catalytic cracking plant, built at the Kent Oil Refinery, on the Isle of Grain, was commissioned on October 15th, and the Anglo-Iranian Oil Company, Ltd., now has three catalytic cracking plants in operation in the United Kingdom.

DUST AND FUME REMOVAL.—We have received from the Visco Engineering Company, Ltd., Stafford Road, Croydon, a brochure entitled "Modern Dust Collection and Fume Removal." Section 1 discusses the problems of dust collection in general and gives numerous examples of the application of plant to various industries. Section 2 deals with the removal of noxious fumes and illustrates different forms of equipment which are available for this purpose.

FILMS ON CONCRETING PLANT.—We were recently invited by Road Machines (Drayton), Ltd., to see some films made for that company to demonstrate certain constructional plant. One of the films depicted the operation of the monorail transporter at a number of civil engineering and building sites; this machine was described in THE ENGINEER of December 9th, 1949. A second film entitled "Why Weigh-Batch?" outlined the advantages of weigh-batching concrete, and showed the firm's portable weigh-batching plant in operation.

CHAIN MAKERS' JUBILEE.—This year the Parsons Chain Company, Ltd., Stourport-on-Severn, is celebrating its golden jubilee. It was founded in 1903 to exploit patents for non-skid tyre chains invented by Mr. H. Parsons. For the first twenty-five years of its life the firm was concerned solely with the manufacture of tyre chains, but when it moved to its present works at Stourport-on-Severn in 1930 its activities were extended to include many other kinds of chain required for a variety of uses at home and abroad. A subsidiary of the company is British Wire Products, Ltd.

MR. W. J. BASSETT-LOWKE.—We note with regret the death of Mr. Wenman Joseph Bassett-Lowke, which occurred on October 21st at the age of seventy-six. Mr. Bassett-Lowke, who was born in Northampton, was the founder of the firm of model makers which bears his name. His grandfather established an engineering business in Northampton in 1859, and it was while serving his apprenticeship there that W. J. Bassett-Lowke formulated his ideas for the establishment of the model making business, the first catalogue of which was issued in 1899. Mr. Bassett-Lowke took a keen interest in the affairs of his native town and retired last year from the Town Council, to which he was first elected in 1930.

GERMAN RE-RAILING EQUIPMENT FOR BRITISH RAILWAYS.—It is announced that, as a result of successful experiments with a re-railing device purchased in Germany last year, three more sets of equipment have been ordered for British Railways. This equipment was described in THE ENGINEER of July 24th last. Locomotives, carriages and wagons have been successfully re-railed with the equipment and without the use of cranes. The new sets of equipment are to be allocated to motive power depots at Gorton (near Manchester), Mexborough, and Darnall (Sheffield), where the use of breakdown cranes with jibs of normal height would be difficult owing to the overhead wires for the future Manchester-Sheffield-Wath electric services.

WEBSTER CHAIR OF ELECTRICAL ENGINEERING.—It is announced that Professor Arnold Tustin, M.I.E.E., head of the Department of Electrical Engineering at the University of Birmingham, has been invited to occupy the Webster Chair of Electrical Engineering as a visiting professor at the Massachusetts Institute of Technology for the academic year 1953–1954. The chair was established last year under a grant of 400,000 dollars from the Edwin Sibley Webster Foundation. In making this announcement, Dr. E. L. Cochrane, Dean of the School of Engineering, said that during his stay at the Massachusetts Institute of Technology Professor Tustin will participate in the development of teaching and research in the applications and uses of electric power.

RADIO VALVE CATEGORISATION.—Some years ago the Scientific Instrument Manufacturers Association produced a list of preferred valves in order to simplify problems of servicing and provide a basis of preferred valves to assist designers of electronic instruments. A second edition, particularly to take into account the greater range of miniature valves now available and to accord with the greater use being made of valves of this size, has now been published. Wherever possible American and Service equivalents are listed. Full technical data on the valves are given, together with base diagrams and other useful information. Copies can be obtained on application to the Secretary, Scientific Instrument Manufacturers Association, 20, Queen Anne Street, London, W.1, price 3s. 6d.

EXPERIMENTAL PHOTOGRAMMETRIC RESEARCH.—An agreement for the setting-up of the European Organisation for Experimental Photogrammetric Research was signed on October 12th at the Paris headquarters of the Organisation for European Economic Co-operation by representatives of Austria, Belgium, Germany, Italy and the Netherlands. Photogrammetry is particularly suited to the rapid production of topographical maps essential for all major engineering projects and for the opening-up of undeveloped territories. In particular, aerial photogrammetry has already produced valuable results in the fields of cartography and geodesy. The new organisation, which will work in close contact with the O.E.E.C., will co-ordinate research work carried out in its member countries to ensure that the maximum benefit is obtained in the execution of map-making programmes. The new organisation will have its headquarters in Delft and will begin work at once.

HISTORIC GATEWAY.—We have been informed by Peter Stubs, Ltd., of Warrington, that the entrance gate to its Rotherham works has been scheduled as a building of special architectural historic interest. The gateway stands on a site which was at one time part of the office and stables of the house of Lord Howard, the first Earl of Effingham, Commander-in-Chief of Her Majesty's Fleet during the reign of Queen Elizabeth the First. The original date of the gateway is no longer available, but in general design and construction it is typical of many buildings that were erected during the reign of William and Mary. The stone from which the gateway was built presumably came from quarries somewhere north of York. The cast iron gates are of more recent origin, as they were erected in 1842. They were made in a foundry in Derby, the main framework being cast integrally as one piece, which in those days must have necessitated the use of a mould weighing many tons. There is obvious similarity between this gateway and that of Euston Station, London, and it has generally been assumed that the Euston entrance was copied from the Stubs gateway.

A LARGE METAL PRETREATMENT AND RECONDITIONING PLANT.—We are informed by Jenolite, Ltd., 43, Piazza Chambers, London, W.C.2, that it was responsible for the design and construction of a large new metal pretreatment and reconditioning plant at the factory of Beherman Demoem S.A., at Mortsel-Antwerp, Belgium. This plant is to be officially opened on November 6th and is to be used for the treatment of tracked and wheeled vehicles for the Belgian Army and the N.A.T.O. forces, including tanks, guns and other equipment. Basically, the plant comprises three immersion tanks, into which components are dipped and which are operated in the following order: (1) degreasing and paint stripping by "Jenolite P.S.5" solution; (2) heavy scale removal by "Jenolite HSR" solution; and (3) rust removal, rust-proofing and paint bonding by "Jenolite R.R.N." The first tank is 29ft by 12ft by 9ft and has a normal working capacity of 16,450 gallons of solution, and the two other tanks are each 30ft by 12ft by 10ft, with working capacities of 15,250 gallons of solution. The "P.S.5" solution tank is steam heated through coils, and the other two by means of steam-heated water jackets.

MOBILE TOWER CRANE DEMONSTRATION.—In a demonstration at the Sunderland works of Steels Engineering Products, Ltd., last week, representatives of the building and civil engineering industries were shown a "Coles" mobile crane which can be arranged as a strut jib crane or a tower crane. This crane is generally similar to the machine described in our issue of July 11, 1952. The tower crane shown in the demonstration is fitted with a 60ft tubular jib and is designed to lift 5 tons at 24ft radius to a height of 82ft, or 2 tons at 42ft radius to a height of 71ft. The operator's cabin at the top of the tower is 36ft above ground level and gives a clear unobstructed view of the full working area. The travel motion can be operated with the tower erected, but for travelling under overhead obstructions the tower can be lowered to provide a clearance height of 22ft 9in. When it is required to use the machine as a strut jib crane it can be converted without the use of ancillary equipment in less than an hour, and fitted with an 80ft tubular jib with a 15ft fly extension. In this form the main jib can be used to lift 5 tons at 26ft radius. The machine can also be fitted with the maker's standard 30ft jib by which 20 tons can be handled at a 10ft radius.

A LARGE CYLINDER BORE GAUGE.—In response to an inquiry from the Department of Scientific and Industrial Research for a suitable cylinder bore gauge for checking bores from 2in to 6in in diameter to a depth of 8ft, British Indicators, Ltd., of St. Albans, Herts, developed and manufactured a suitable instrument designed to overcome some of the problems to be encountered in taking accurate measurements of this nature. The gauge can be broken down into three pieces for transit and each section is threaded to enable it to be interchanged with any other section of the instrument. Thus, the total length of the gauge can be 2ft 9in, 5ft 6in or 8ft, for convenience in working at intermediate depths. If comparatively shallow bores are to be checked one section only need be used. A special tension adjusting device is provided on the first section of the instrument, which incorporates the transmission and centralising shoe of the gauge. Operation of the gauge necessitates a central push rod operating from the plunger of the shoe to the plunger of the dial indicator, and this push rod is made of light alloy tubing. The total weight of three 2ft 9in sections becomes a factor which affects the sensitivity of the instrument, but by varying the position of the adjusting collar which operates the tension of the supporting spring of the centre push rod, the dead weight of the rod can be counterbalanced. It is stated that the sensitivity of the instrument is such that operating pressures as low as 4 oz can be obtained at the gauging plunger.

Personal and Business

BRUCE PEEBLES AND CO., Ltd., Edinburgh, announces that Mr. W. B. Laing, M.I.E.E., has been appointed general manager.

THE SPERRY GYROSCOPE COMPANY, Ltd., Brentford, announces the appointment of Mr. W. G. Lisle as manager of the hydraulics department.

MR. E. N. ROBINSON, deputy chairman of A. Reyrolle and Co., Ltd., has been appointed to the board of C. A. Parsons and Co., Ltd., Newcastle upon Tyne.

MACROME, Ltd., Aldersley, Wolverhampton, has been appointed sole sales manager for the hand tool division of Bren Manufacturing Company, Ltd., Gateshead, 11.

METALOCK (BRITAIN), Ltd., states that its agency in South Wales is now in the hands of Hinchliffe and Partners, Ltd., 6, Park Grove, Cardiff (telephone, Cardiff 29719).

ELLIOTT BROTHERS (LONDON), Ltd., Lewisham, S.E.13, announces the appointment of Mr. H. C. Pritchard, F.R.Ae.S., as deputy general manager in charge of science.

LLOYD'S REGISTER OF SHIPPING states that Mr. H. L. Sutherst, principal surveyor on the London outdoor staff, will retire on December 31st. He is to be succeeded by Mr. T. A. Orde.

DECCA RADAR, Ltd., 1–3, Brixton Road, London, S.W.9, states that Mr. L. J. Dennett has been appointed general manager of its associated company, Decca Radar (Canada), Ltd.

MR. H. C. MARGRETT has been appointed manager of the business development department of the General Electric Company, Ltd., in succession to Mr. P. H. Nye, who has recently retired.

BURTON, GRIFFITHS AND CO., Ltd., has appointed Mr. F. Short as small tools representative in South Wales. His address is Index Works, Curran Road, Cardiff (telephone, Cardiff 24111).

THE EARL OF DUDLEY has retired from the board of British Iron and Steel Corporation, Ltd., of which he has been chairman since its inception in 1935. Sir Charles Bruce-Gardner, Bart, has been appointed chairman.

ALLEY AND MACLELLAN, Ltd., Worcester, announces the appointment of Mr. A. Robertson as general manager, following the retirement of Mr. J. R. Wilson from the position of managing director. Mr. Wilson will continue to serve on the board of the company.

METROPOLITAN-CAMMELL CARRIAGE AND WAGON COMPANY, Ltd., Saltley, Birmingham, 8, states that Sir Archibald J. Boyd will retire from the position of managing director at the end of this year, and will be succeeded by Mr. H. N. Edwards, who is at present assistant managing director. Sir Archibald will continue to serve on the board of the company and will be available in an advisory capacity in London. Mr. A. T. Cheesley, production general manager and a director of the company, will also retire on December 31st and will be succeeded by Mr. Norman Haddon, who is at present works manager at Saltley. Mr. Harry Green, special director and chief engineer (designs), will join the board of the company on January 1st next.

British Patent Specifications

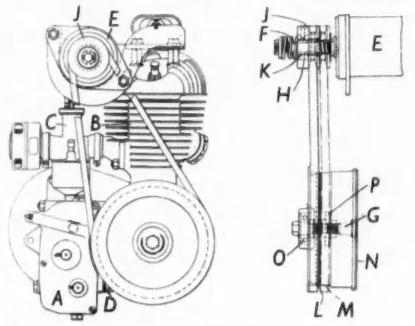
When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings. The date first given is the date of application: the second date, at the end of the abridgment, is the date of publication of the complete specification.

Copies of specifications may be obtained at the Patent Office Sales Branch, 15, Southampton Buildings, Chancery Lane, W.C.2 2s. 8d. each.

INTERNAL COMBUSTION ENGINES

697,893. January 9, 1952.—ENGINE TURNING GEAR, The Stanley Engineering Company, Ltd., 17, The Avenue, Egham, Surrey. (*Inventor: Robert Philip Hewson.*)

The invention has for its object to provide an improved form of turning gear for starting of light internal combustion engines. Referring to the drawings, there is shown a main supporting frame *A* for the cylinder *B*, a carburettor *C*, a crankcase *D*, and a starting device *E*, with its driving shaft *F* parallel to the engine shaft *G*. The shaft of the starter device *F* has on it a helical thread *H*, on which is mounted a cast iron driving pulley *J* grooved for a vee belt. The pulley has a helical thread *K* which engages the thread *H* in such a way that the pulley can slide along the shaft. The pulley is the driving member of



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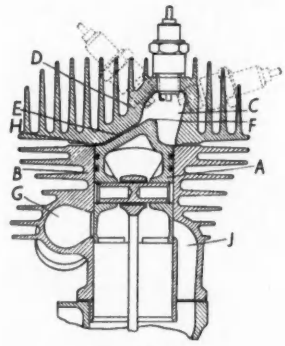
the engine turning gear, and is coupled to the engine shaft by means of a belt which passes round the pulley *J* and also a second pulley mounted on the engine shaft. This second pulley has two parts *L* and *M*, each of which is wide enough to carry the belt. One part *M* consists of an extension to the flywheel *N*, while the other part *L* rotates on a ball race *O* secured to an internal shaft *P*. The driving and driven pulleys are so arranged that when the engine is stationary, the freely mounted pulley L is immediately below the driving pulley *J* so that the belt is free to rotate. When, however, current is supplied to the starting device, the sudden rotation of the shaft *F* of the starter device acting against the inertia of the driving pulley *J*, causes it to slide inwards along the helical thread H, thereby bringing the belt to the part *M* of the driven pulley attached to the flywheel of the engine. As soon as the engine starts up and power is cut off from the starter device, the driving pulley *F* slides back into the original position, so that the flywheel and its shaft again run freely.—*September* 30, 1953.

697,651. February 8, 1950.—CYLINDER HEADS FOR TWO-STROKE ENGINES, Fichtel and Sachs, A.-G., Schweinfurt a.M., Germany.

The object of the invention is to provide satisfactory cooling of the piston especially in the case of scavenging systems in which the scavenging streams are not



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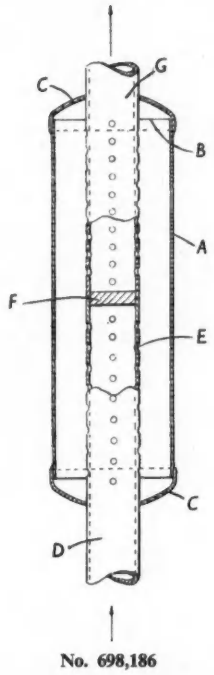
led over the piston. In the drawing the nosed piston *A* in the cylinder *B* is shown in upper dead centre position. The inner surface of the combustion chamber *C* in the cylinder head *D* is designed in such a way that the left-hand part *E* of the surface is less than 2mm from the piston head surface *F*. At the side corresponding to the exhaust channel *G* the piston edge portion *H* which controls the exhaust port is, therefore, covered by the cylinder head. In this position of the piston no combustion takes place in the vicinity of the piston edge *H*. At the side corresponding to the inlet channel *J* is the combustion chamber *C* proper, which can be reached by the entering gases without passing over disturbing edges. The sparking plug is provided in the part of the combustion chamber *C* which is farthest away from the piston head. Alternatively, the sparking plug may be arranged in the positions shown in broken lines, when the longitudinal axis of the plug extends towards the side wall of the combustion chamber *C*. Accordingly, the ignition flame caused by the plug meets that part of the wall of the combustion chamber which is not formed by the piston head surface. Modified designs for flat-topped pistons and a central combustion chamber are also shown in the specification.—*September* 30, 1953.

697,946. March 17, 1952.—IGNITION MAGNETOS, Scintilla, Ltd., Soleure, Switzerland.

The invention relates to ignition magnetos of reduced size. In the magneto the axes of rotation of the rotor and distributor shafts are parallel to each other and the transmission of the drive from the rotor shaft to the distributor shaft is effected by means of a chain or a flexible substantially non-elastic toothed belt embracing the two driving elements.—*September* 30, 1953.

698,186. September 20, 1950.—EXHAUST SILENCERS, Reginald John Sanders, 256, Corporation Street, Birmingham.

In the construction shown in the drawing the expansion chamber is formed as a metal cylinder *A* having open ends *B* and provided at each end with domed end caps *C*. The inlet pipe *D* passes through a central hole in one end cap. Within the chamber the



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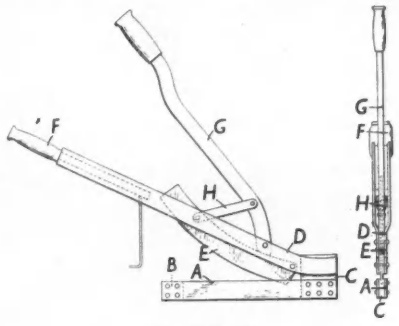
pipe has a number of apertures *E* in its wall and at its inner end a plug *F* is secured with part of the plug disposed in the end of the pipe and part projecting. The outlet pipe *G* is similarly arranged, and at its inner end is secured to the plug *F*. The space between the inside of the cylinder *A* and the inlet and outlet pipes may be packed with glass wool. The invention provides a particular simple form of construction for an exhaust silencer which lends itself to a relatively cheap and easy manufacturing process.—*October* 7, 1953.

WORKSHOP TOOLS AND APPLIANCES

697,008. February 18, 1950.—GUILLOTINE SHEARS FOR CUTTING ASBESTOS AND SHEET MATERIAL, Joseph Appleyard, School Lane, Boston Spa.

As the drawings show, the shears comprise two parallel blades *A* held by a spacing piece *B* at one end, the free ends being secured to a plate *C* to form the base of the guillotine. A forked member *D* is secured to the blade plate *C* and on it is pivotally mounted one end of a curved double-edged blade *E*. The forked member *D* is inclined to the base members and provides a handle *F* for holding and guiding the guillotine when cutting material. This forked member also carries a lever *G* which is pivotally mounted at a suitable distance from the pivoted end of the blade; a link *H* connects the lever *G* with the free end of the blade permitting it to be moved about



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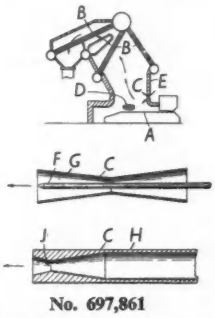
its fulcrum by corresponding movement of the lever *G* fulcrumed on the forked member *D*. In operation, the double-edged blade and adjacent edges of the fixed blade members cause a double cut to be made in the asbestos. The action of the guillotine is such that it minimises risk of breaking the sheet material as it does not splice or bend the sheet in its action of cutting.—*September* 16, 1953.

FURNACES

697,861. February 9, 1951.—BOILER FURNACES, Charrington, Gardner, Locket and Co., Ltd., of Tower House, 40, Trinity Square, London, E.C.3. (*Inventors: Alexander MacFarlane Russell and John Terence Brownrigg Bookey.*)

The invention provides a method of inhibiting, in coal-fired boiler furnaces, oxidation of sulphur in the fuel to SO_3, which comprises forming, by injection, into the furnace of an organic inhibitor, a cloud of carbon particles above the fuel bed at a region where smoke does not form during normal firing of the furnace. The drawings show a mechanically stoked water-tube boiler arranged according to the invention and alternative types of injector for the inhibitor. The boiler is provided with a chain-grate stoker *A* and the combustion gases pass through the boiler tubes *B* as shown by the arrows. In each case the boiler furnace is provided with an injector *C* arranged



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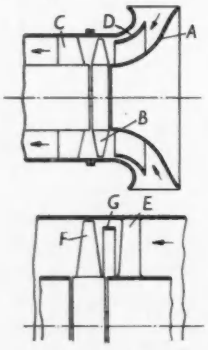
to inject an inhibitor so as to produce a cloud *D* of carbon particles over the fuel bed on the rear of the grate. The injector is fitted into the front wall *E* of the furnace. In order to prevent premature combustion of the inhibitor the jet delivered is surrounded by an envelope of steam, flue gas or inert gas, or a mixture of two or more of these. In the injector shown in the centre view the inhibitor, in liquid or finely divided solid form, is fed under pressure along a central tube *F*, while flue gases, steam or an inert gas are caused to flow through a venturi tube *G* surrounding the tube *F*. The alternative form of injector shown in the lower view comprises a tube *H*, through which the inhibitor flows, and having a venturi jet *J* at its mouth. For small distances the injector shown may be used, but in the case of a longer throw, however, the tube *H* should be surrounded by an outer tube, through which flue gas, steam or inert gas is passed to form a combustion-retarding envelope surrounding the pencil or spray of inhibitor delivered from the jet.—*September* 30, 1953.

BLOWERS AND PUMPS

697,748. February 8, 1951.—AXIAL-FLOW BLOWERS AND PUMPS, J. M. Voith G.m.b.H., Heidenheim, (Brenz), Germany.

The object of the invention is to provide an arrangement which will enable a stable characteristic to be obtained for axial-flow blowers and axial-flow pumps without an inlet nozzle with purely axial flow. Referring to the upper drawing, an inlet nozzle *A* is provided before the impeller *B* and behind it is

arranged a guide wheel *C*. A suction ring *D* is built in the inlet nozzle. In the construction shown in the lower view a guide wheel *E* is provided before the impeller *F* and in between these two there is inserted a thin stationary cylindrical ring *G* of a comparatively large diameter, at least eight-tenths of the outer diameter of the impeller. In the case of a multi-



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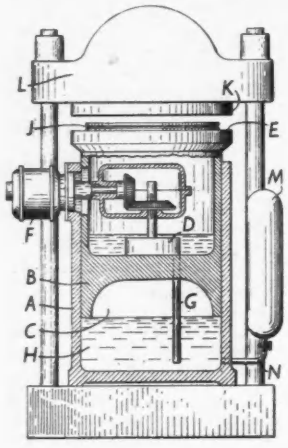
stage construction of the axial-flow blower an intermediate ring is provided in each stage between the guide wheel and the impeller. A diagram given in the specification shows the static pressure difference or delivery head as a function of the amount of flow and also the sound pressure for a construction with and without the improvement described.—*September* 30, 1953.

HYDRAULIC MACHINERY

698,218. September 4, 1951.—HYDRAULIC PRESSES, Hedwig Gamble and Lisbeth Schwarg, Lea Valley Road, Ponders End, Middlesex; and 7, Britton House, Chelsea, London, S.W.3.

The invention provides a hydraulic stamping press in which the rise of pressure under the action of the hydraulic medium is regulated from the beginning of the impressing step in such a manner that the pressure always corresponds to the degree to which the material to be pressed has been softened. As shown, the press cylinder *A* has a ram *B* with a recess *C*. The recess contains an air pocket for regulating the pressure rise. The high-pressure pump *D* at the top of the ram carries the press platen *E*. As indicated in the drawing, the high-pressure pump may be operated by an electric motor *F* through bevel gearing to force the liquid from above the ram through the



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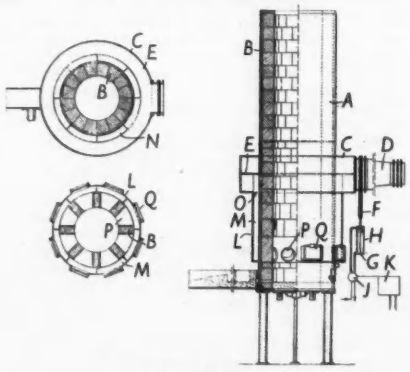
pipe *G* into the high-pressure chamber *H* of the cylinder and thus to lift the ram. Under the pressure produced by the pump the press platen *E* forces the die *J* upwards against the fixed top plate *K*, held by the frame *L* of the press. This frame is rigidly connected with the press cylinder. As the impression begins the air in the recess *C* is compressed, the degree of compression always corresponding to the counter-pressure to which the press platen *E* is subjected. As a result the pressure rises gradually until the full pressure provided by the pump *D* has been reached. When the volume of the air pocket *C* is insufficient, additional air may be introduced from a pressure cylinder *M* through a pipe *N* to cause the pressure to rise even more gradually.—*October* 7, 1953.

METALLURGY

697,979. October 30, 1950.—FOUNDRY CUPOLA, Robert Andre Marcel Ronceray, 2, Rue Saint-Sauveur, Thais (Seine), France.

The invention has for its object to provide an improved design of foundry cupola, which enables automatic removal of tuyere deposits, and uniformity of air pressure throughout the tuyeres, with reduced losses of head, a lessening of cupola facing wear,



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and a preheating of the air supply. Referring to the drawings, *A* is a cupola having a lining *B*; surmounting the cupola is an air distributor box *C* connected to an air supply duct *D* and divided into two compartments by a transverse partition *E*. A shutter *F* having an aperture is placed within the duct to cut off the air supply to the tuyeres depending on the position of the aperture and whether it is in registration with the upper or lower compartment of the box *C*. Operation of the shutter is by means of a piston *G* in a double-acting cylinder *H* connected to a supply of compressed air, which may be supplied to one or the other cylinder ends through a three-way control valve *J* actuated by an adjustable clockwork timing mechanism *K*. A jacket *L* surrounds the cupola below the air box *C* and is provided with partition plates dividing the interior of the chamber within jacket *L* into down passages *M*. One of every two of these down passages communicates with the upper compartment of the air box through openings *N* in the partition *E*, while the other and intermediate passages communicate with the lower compartment of this box through apertures *O* in the bottom wall of the box. At their lower ends the passages *O* open into converging tuyeres *P* equally spaced circumferentially of the cupola and all arranged in the same plane. Inspection doors *Q* are provided at the front of the tuyeres. The clockwork mechanism *K* sets in operation alternately the tuyeres *P* which are in communication with the upper portion of the air box *C* and the tuyeres which are in communication with the lower portion of this box. The tuyeres not in action are brought to a high temperature and their deposits melt away. The air flowing into the jacket *L* is heated, the air pressure being practically equal in all of those tuyeres in action.—*October* 7, 1953.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

BRITISH INSTITUTION OF RADIO ENGINEERS

Thurs., Nov. 5th.—SCOTTISH SECTION: The University, Edinburgh, Annual General Meeting, 6.30 p.m., "Vibration Generators—Their Ancillary Equipment and Application," H. Moore, 7 p.m.——MERSEYSIDE SECTION: Electricity Board Service Centre, Whitechapel, Liverpool, "Multi-Channel Tuners for Television," S. L. Fife and W. E. Hosey, 7 p.m.

CHEMICAL SOCIETY

Thurs., Nov. 5th.—Lecture Theatre, Imperial College of Science and Technology, South Kensington, London, S.W.7, "Aromatic Character in Seven-Membered Ring Systems," A. W. Johnson, 7.30 p.m.

ELECTRIC RAILWAY SOCIETY

Tues., Nov. 3rd.—LONDON BRANCH: Royal Society of Arts, John Adam Street, Adelphi, Strand, W.C.2, "The Functions of Materials Handling in Industry," L. Landon Goodman, Film, "A Case for Handling," 6.30 p.m.

Wed., Nov. 4th.—SOUTHAMPTON BRANCH: Polygon Hotel, Southampton, "Employers' Liability," Robert Hughes, 7.30 p.m.

Thurs., Nov. 5th.—Fred Tallant Hall, 153, Drummond Street, London, N.W.1, "Track Circuits Aid Traffic Flow," B. J. Prigmore, 7.15 p.m.—PETERBOROUGH BRANCH: Eastern Gas Board's Demonstration Theatre, Church Street, Peterborough, "The Heat Pump," 7.30 p.m.

Mon., Nov. 9th.—DUNDEE BRANCH: Mathers Hotel, Dundee, "Hydraulics as Applied to Machine Tools," T. Ransome, 7.30 p.m.

INCORPORATED PLANT ENGINEERS

To-day, Oct. 30th.—BIRMINGHAM BRANCH: Imperial Hotel, Birmingham, "Calculating Machines: Past and Present," G. A. Montgomerie, 7.30 p.m.

INSTITUTE OF FUEL

Thurs., Nov. 5th.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1, "French Power Resources and Their Utilisation," J. Couture, 5.30 p.m.

INSTITUTE OF MARINE ENGINEERS

Mon., Nov. 2nd.—MERSEYSIDE AND N.W. SECTION: 24, Dale Street, Liverpool, "Operation of a Marine Gas Turbine Under Sea Conditions," J. Lamb and R. M. Duggan, 6.30 p.m.——JUNIOR LECTURE: 85, Minories, London, E.C.3, "The Steam Reciprocating Engine," 6.30 p.m.

Thurs., Nov. 5th.—JUNIOR LECTURE: Technical College, Wimbledon, "Marine Diesel Engines," A. G. Arnold, 7.30 p.m.

INSTITUTION OF CHEMICAL ENGINEERS

Tues., Nov. 3rd.—Geological Society, Burlington House, Piccadilly, London, W.1, "Agitation in Process Design," S. J. Green, 5.30 p.m.

INSTITUTION OF CIVIL ENGINEERS

To-day, Oct. 30th.—YORKSHIRE ASSOCIATION: Royal Victoria Station Hotel, Sheffield, "Traffic Engineering in the U.S.A.," J. A. Hillier, 7 p.m.——MIDLANDS ASSOCIATION, GRADUATES' AND STUDENTS' MEETING: Room 129, Civic Centre, Birmingham, "Design and Erection of T.V. Masts," 6.30 p.m.

Tues., Nov. 3rd.—ORDINARY MEETING: Great George Street, Westminster, London, S.W.1, Presidential Address, W. P. Shepherd-Barron, 5.30 p.m.

Fri., Nov. 6th.—N.W. ASSOCIATION: Engineers' Club, Albert Square, Manchester, "The Control of Water for Food Production," H. Addison, 6.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS

Mon., Nov. 2nd.—LONDON STUDENTS' SECTION: Savoy Place, W.C.2, "Development of Electrical Aids in A.A. Gunnery," D. H. A. Huddart, 7 p.m.——N. MIDLAND CENTRE: James Watt Institute, Birmingham, "The Co-ordination of Insulation of High-Voltage Electrical Installations," J. S. Cliff; "Electrical Discharges in Air Gaps Facing Solid Insulation in High-Voltage Equipment," E. Friedlander and J. R. Reed, 6 p.m.

Tues., Nov. 3rd.—MEASUREMENT SECTION: Savoy Place, London, W.C.2, Discussion on "Standardised Protective Transformers from the Point of View of Maker and User," opened by H. S. Petch and J. G. Wellings, 5.30 p.m.——S.E. SCOTLAND SUB-CENTRE: Carlton Hotel, North Bridge, Edinburgh, "Certain Aspects of Solid State Physics in Electro-Photography," W. D. Oliphant, 7 p.m.

Wed., Nov. 4th.—TEES-SIDE SUB-CENTRE: Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough, "A Brief Review of Engineering Problems Associated with the Integration of the Undertakings in the N.E. Electricity Board's Area of Supply," T. M. Ayres, 6.30 p.m.——S.W. SCOTLAND SUB-CENTRE: Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, "Electro Technical Ceramics—Composition, Manufacturing Methods and Properties," W. G. Robinson and E. C. Bloor, 7 p.m.

Thurs., Nov. 5th.—ORDINARY MEETING: Savoy Place, London, W.C.2, "The Co-ordination of Insulation of High-Voltage Eectrical Installations," J. S. Cliff, 5.30 p.m.

INSTITUTION OF ENGINEERING INSPECTION

Tues., Nov. 3rd.—COVENTRY BRANCH: Technical College, Coventry, "Physical Tests on Engineering Materials," A. Binns, 7.30 p.m.

Wed., Nov. 4th.—BIRMINGHAM BRANCH: Chamber of Commerce, Birmingham, "Non-Destructive Testing," Mr. Hislop, 7.30 p.m.

Thurs., Nov. 5th.—LONDON BRANCH: Royal Society of Arts, John Adam Street, W.C.2, "Footwear Research—Principles and Programme," H. Bradley, 6 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND

Tues., Nov. 3rd.—39, Elmbank Crescent, Glasgow, "The Application of Conveyors to the Handling of Materials in Bulk," J. Findlay, 6.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS

To-day, Oct. 30th.—GENERAL MEETING: Storey's Gate, St. James's Park, London, S.W.1, "Some Practical Aspects of Cutting Tool Nomenclature Arising from Recent Research," D. F. Galloway, 5.30 p.m.

Fri., Nov. 6th.—GENERAL MEETING: Storey's Gate, St. James's Park, London, S.W.1, "Present Trends in Surge Tank Design," C. Jaeger, 5.30 p.m.

INSTITUTION OF PRODUCTION ENGINEERS

Tues., Nov. 3rd.—NOTTINGHAM SECTION: Welbeck Hotel, Milton Street, Nottingham, "Work Measurement," T. U. Matthew, 7 p.m.

Thurs., Nov. 5th.—GLASGOW SECTION: Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow, Open Discussion Night, 7.30 p.m.

Sat., Nov. 7th.—COVENTRY SECTION: Visit to Alfred Herbert, Ltd., Threading Factory, Black Horse Lane, Exhall, Coventry, 9.30 a.m.

INSTITUTION OF STRUCTURAL ENGINEERS

To-day, Oct. 30th.—MIDLAND COUNTIES BRANCH: Room 129, Civic Centre, Birmingham, "The Design and Erection of B.B.C. Television Masts," 6.30 p.m.

Tues., Nov. 3rd.—NORTHERN COUNTIES BRANCH: Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough, "The Use of Structural Steel in Buildings," L. R. Creasy, 6.30 p.m.

Wed., Nov. 4th.—NORTHERN COUNTIES BRANCH: Neville Hall, Newcastle, "The Use of Structural Steel in Buildings," L. R. Creasy, 6.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS

To-day, Oct. 30th.—Townsend House, Greycoat Place, London, S.W.1, Film Evening, 7 p.m.

Fri., Nov. 6th.—Alliance Hall, Palmer Street, London, S.W.1 "Peak Loads and Heat Storage," W. Goldstern, 7 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS

To-day, Oct. 30th.—The Engineers' Club, Albert Square, Manchester, "Water Turbines and Their Applications," G. M. Hardman, 6.45 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS

To-day, Oct. 30th.—Literary and Philosophical Society's Lecture Theatre, Newcastle upon Tyne, "Internal Stresses in Some Types of Forgings," C. Sykes, 6.15 p.m.

Fri., Nov. 6th.—Mining Institute, Newcastle upon Tyne, "The Influence of Thermal Effects on the Manœvrability of Marine Turbine Machinery," P. J. Terrell, 6.15 p.m.

REINFORCED CONCRETE ASSOCIATION

Wed., Nov. 4th.—11, Upper Belgrave Street, London, S.W.1, "Reinforced Concrete Highway Bridges," C. S. Chettoe, 6 p.m.

ROYAL AERONAUTICAL SOCIETY

Tues., Nov. 3rd.—4, Hamilton Place, London, W.1, "The Development of 4000 lb Hydraulic Systems," G. Orloff, 7 p.m.

Thurs., Nov. 5th.—GRADUATES' AND STUDENTS' SECTION: 4, Hamilton Place, London, W.1, "The Exploration of Space," Arthur C. Clarke, 7.30 p.m.

SHEFFIELD SOCIETY OF ENGINEERS AND METALLURGISTS

Tues., Nov. 3rd.—B.I.S.R.A., Hoyle Street, Sheffield, "The W1400 Walking Dragline," 7 p.m.

SOCIETY OF ENGINEERS

Mon., Nov. 2nd.—Geological Society, Burlington House, London, W.1, "Prestressed Concrete in Civil Engineering Works," A. J. Harris, 5.30 p.m.